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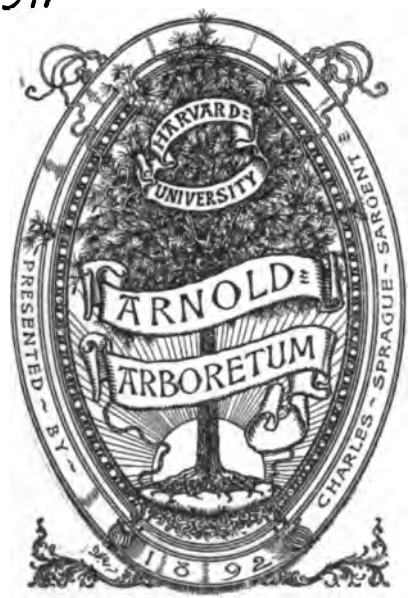
HARVARD UNIVERSITY
ARNOLD
ARBORETUM
PRESENTED BY
CHARLES SPRAGUE SARGENT
1892

MEMOIRS

OF THE

TORREY BOTANICAL CLUB

VOLUME VI

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MEMOIRS
OF THE
TORREY BOTANICAL CLUB.

Vol. VI. No. 1.

On the Collections of Mr. Miguel Bang in Bolivia.—Part III.

By Henry H. Rusby.

CORRECTIONS, ADDITIONS AND NOTES REFERRING TO PARTS I. AND II.*

226. (Omitted in Part II. of my Enumeration) is *Euphorbia pilulifera* L. Yungas, 1890.

230. (Missed in Part I.) is *Polygala Bangiana* Chodat, sp. n. Bull. Herb. Boiss. 4: 234. Yungas, 1890.

256b. (Missed in Part II.) is *Siphocampylos corymbiferus* Pohl, Fl. Bras. Ic. 2: 112. *pl. 175*. Yungas, 1890.

384. (Missed in Part I.) is *Sabicea cinerea* Aubl. Pl. Gui. 1: 192. *pl. 75*. Yungas, 1890.

430. (Enumerated as *Tibouchina stenopetala* Cogn.). Of this M. Cogniaux writes as follows:

En examinant attentivement cette plante, il me semble que ce n'est pas le *T. stenopetala*, mais bien l'une des formes du très variable *T. longifolia* Baill. Le *T. stenopetala* est une plante plus grèle, moins velue; les soies du calice sont *étalés* et *glanduleuses*, les étamines sont plus inegales, les plus grandes ayombant le connectif notablement plus long, etc.

500. (Enumerated as *Centropogon Surinamensis* (L.) Presl), is a new species shortly to be published by A. Zahlbruckner in Bull. Torr. Bot. Club.

520. (Published as *Lisianthus ovalis* R. & P.) is being studied by Dr. Gilg, who thinks the determination wrong.

* Mem. Torr. Bot. Club, 3: Part 3, and 4: Part 3.

698. (Published as *Monnina cestrifolia* H. B. K.) is *Monnina Autraniana* Chodat, Bull. Herb. Boiss, 3: 543.

738. (Published as *Siphocampylos giganteus latifolius* Britton) is a new species of *Centropogon*, shortly to be published by A. Zahlbruckner in Bull. Torr. Bot. Club.

843. *Erythroxylon Bangii* Rusby has been examined in the chemical laboratory of Messrs. Parke, Davis & Co., for the presence of cocaine in its leaves, with negative results.

969. (Published as *Cacabus parviflorus* Rusby) is *Physalis viscosa* L., as kindly pointed out by Mr. Rydberg.

Enumeration of Nos. 1001-1769.

RANUNCULACEAE.

Clematis sericea H. B. K. Nov. Gen. 5: 37. Espirito Santo, near Cochabamba, 1891 (1271).

Thalictrum podocarpum H. B. K. Nov. Gen. 5: 38. Vic. Sorata, May, 1892 (1314) = 758 and 893 and Rusby's 501 and 502.

Anemone triternata Vahl, Symb. 3: 74. *pl. 65.* Near snow line, Mt. Tunari, 1891 (1041)= Rusby's 1753.

DILLENIACEAE.

Davilla rugosa Poir. Encyc. Meth. Supp. 2: 457. Var. (?) CAPITATA n. var. Distinguished from all specimens of the type by its very abundant capitate clustered flowers. Apparently intermediate between *D. rugosa* and *D. elliptica.*

Between Mapiri and Tipuani, July–Aug., 1892 (1524). Also collected by Pearce at Chailla.

DAVILLA LECHLERI sp. n.

Finely papillose-scabrous throughout, the branches of the inflorescence sparsely coarse-hairy; branches elongated, terete; petioles 1–1.5 cm. long, margined, with dilated base, blades 9–13 cm. long, 5–7 cm. broad, oval, with base very abruptly contracted into the petiole, apex abruptly produced into an obtusish point 3–6 mm. long and broad, and margin serrate with rather distant, erect teeth spinulose toward the apex, obsolete toward the base, pale, membranaceous, the 13–15 pairs of primaries distinctly impressed above; floral leaves scarce, obovate, 2 cm. long or less; panicles terminal and in the upper axils, 8–16 cm. long, 5–12 cm. broad, the branches distant and lax, the flowers rather densely clustered, sessile to sub-sessile; mature buds 3–3.5 mm. in diameter; petals 2 or 3, strongly veined.

Espirito Santo, 1891 (1249).

The same as Lechler's 2316 from Peru.. Nearly Jenman's Guiana no. 2146, but that has short thick petioles and thick sharply ribbed blades.

DAVILLA PARVIFLORA sp. n.

Scabrous throughout, the branches rather stout, flexuous, terete, or obscurely angled above, brown, the internodes very unequal; petioles 5–10 mm. long, margined, dilated at the base; blades 6–12 cm. long, 3–6 cm. broad, oval to oval-obovate, with base abruptly contracted into the petiole, apex rounded and very slightly obtusely pointed, and margin sinuate-serrate with mucronate teeth, especially toward the apex; thickish, rigid, midrib impressed above, the 13–16 pairs of primaries parallel, slightly curved, angle about 60°, obscure above, finely and sharply prominent underneath, connected by fine secondaries, which are reticulate; panicles terminal, the branches in the axils of the floral leaves mostly short-peduncled, about 4 cm. long, loosely flowered; bracts oblong, gray-hairy, about 1 mm. long; flowers on short stout angled pedicels; buds globose, 2.5 mm. in diameter; petal one, or a second small one; filaments but little thickened above, style very thick, one-half longer than the stamens.

Between Guanai and Tipuani, April–June, 1892 (1377).

DOLIOCARPUS FERRUGINEUS sp. n.

Coarse, the branches thick but weak, angled, below sparsely, above densely ferruginous-hirsute, the hairs divaricate or slightly retrorse, internodes mostly less than 3 cm. long; petioles very thick, 1–2 cm. long, hirsute like the upper parts of branches; blades 1–3 dm. long, 6–12 cm. broad, irregularly oval with subcuneate base, acute or slightly acuminate apex, and sinuately serrate margin, the teeth distant, coarse, mucronate; membranaceous and thin, above dark, nearly smooth except upon the scabrous impressed midrib and 12–14 pairs of primaries, which are nearly straight, diverging at about 45°, underneath pale yellowish green, sparsely hirsute, densely so with retrorse hairs upon the midrib and sharply prominent primaries, which are connected by the numerous fine secondaries; flowers in simple or slightly compound sessile axillary clusters, the pedicels 3–10 mm. long, slightly thickened at the apex, hirsute; mature buds globose-obovoid, 4 or 5 mm. long; filaments only slightly thickened above.

Espirito Santo, 1891 (1261 and part of 1266).

ANONACEAE.

Guatteria eriopoda DC. Syst. 1: 505 (?). Espirito Santo, 1891 (1176).

Specimen more ferruginous than either Matthew's 3054 or my 1240, and the leaves and flowers much larger.

MENISPERMACEAE.

Cissampelos Pareira L. Sp. Pl. 1031. Mapiri, July–August, 1892 (1552a and 1553) = Rusby's 1444, etc.

BERBERIDEAE.

Berberis Agapatensis Lechl. Berb. Austr. 44 (?). A little above Cochabamba, 1891 (1091).

Spines larger (some 5-parted) and leaves broader than in the type.

BERBERIS PHYLLACANTHA sp. n.

Stout, densely branched and densely leafy, the branches at an angle of about 45 degrees, slender, nearly straight; branches nearly terete, blackish or dark brown with grooved fissures; branchlets terete, not fissured, scurfy-puberulent; spines phylloid, 12–24 mm. long, with well-differentiated petioles and veins, of one or two pairs of lateral and a terminal division, all similar, triangular-subulate and very pungent, yellowish-brown; branchlets about 6-leaved, the scales blackish, of similar form and markings to the petioles of the spines, closely appressed; petioles distinct but mostly concealed by the scales, 2–5 mm. long, dilated downward, orange-colored, 5–7-costate; blades 1–2.5 cm. long, 5–15 mm. broad, obovate with cuneate base, pungent broad apex and about 3 pairs of large triangular pungent teeth with obtuse sinuses, margin slightly revolute; very thick and rigid, glabrous, above bright or pale green and shining, underneath yellowish, the veins prominent on both sides, especially underneath; flowers mostly solitary, from reddish bracts 7 mm. long by 10–12 mm. broad, on scabrous upwardly thickened pedicels 6–7 mm. long, the sepals orange-yellow with a red middle portion; fruit black, glaucous, globose, 8 mm. in diameter, tipped by the style and large stigma.

Sorata, Nov., 1892 (1614).

The same as Mandon's no. 862.

CAPPARIDEAE.

Cleome glandulosa R. & P. ex DC. Prod. 1: 238. Espirito Santo, 1891 (1197) = Rusby's 734.

Cleome aculeata L. Syst. Ed. 12, 3: 232. Guanai, July, 1892 (1585.)

CAPPARIS BANGII sp. n.

Minutely scabrous throughout, the sepals light gray outside; branchlets terete, flexuous, the internodes about 1–2 cm. long; stipules setaceous, caducous; petioles 5–7 mm. long, broad; blades 5–8 cm. long, 2–4 cm. broad, ovate with rounded base and short-pointed obtusish apex, coarsely sinuate-dentate toward the apex, coriaceous and rigid, above dark green and finely lepidote, underneath pale, venation inconspicuous above, the midrib and 5 or 6 pairs of primaries somewhat prominent underneath; flowers solitary in the axils, on stout angled gray peduncles 1.5 cm. long; bud oblong, obtuse; sepals valvate, free, 2 cm. long, linear-oblanceolate, obtuse, gray without, reddish (?) and scurfy within; petals a little exceeding the sepals, apparently rose-colored; stamens very numerous, shorter than the pistil; fruit not seen.

Tipuani, Jan., 1893 (1642).

VIOLARIEAE.

Viola veronicaefolia Pl. et. Lind. Ann. Sci. Nat. (IV.) 17: 121. Vic. Mapiri, 12,000 ft., Sept., 1892 (1578) = 823.

Viola pygmaea Juss.; Poir. in Lam. Encyc. 8: 630. Vic. Mapiri, 12,000 ft., Sept., 1892 (1579 and 1579a). Also collected by Mandon and by Pearce in the Andes of Yungas.

VIOLA BANGII (= *V. nivalis* Benth. Pl. Hartw. 160, not R. & S.). Sorata, Nov., 1892 (1616) = Mandon's 940, and collected by Jameson and others in Ecuador.

RINOREA VIRIDIFOLIA sp. n.

Glabrous, fruticose, much branched, the branches and branchlets slender, ascending, grayish-brown; leaves opposite; petioles 3–10 mm. long, dark, stout; blades of the pair slightly unequal, 4–10 cm. long, 1.5–5 cm. broad, oblong to oval or obovate, with sub-rotund or blunt base, abruptly pointed obtuse apex and slightly sinuately serrate margin, the teeth rounded; bright green both sides, membranaceous; racemes terminal, about 2.5–4 cm. long exclusive of the peduncle, which is one-half as long, loosely flowered; bracts scarious, two-fifths the length of the pedicels, broadly ovate, keeled; pedicels erect, stout, thickened above, dark, 2–3 mm. long; mature bud lance-ovoid, obtuse, nearly 5 mm. long; sepals one-fourth as long as the petals, nearly semicircular, whitish; petals lanceolate, yellowish with whitish recurved rounded apex; stamens entirely distinct; scale at back of filament nearly as long as the filament, oval, with rounded apex; anther as long as filament; appendage of connective triangular-acuminate, acute, forming two broad wings to the anther, the terminal subulate portion

as long as the anther, not equalling the petals; ovary coarsely hirsute; style slenderly conical, pubescent, slightly exceeding the anther-appendages; fruit not seen.

Between Guanai and Tipuani, April–June, 1892 (1337).

The same as Spruce's 1855b, from Tarapota, Peru. Probably the same as Rusby's 2493 in advanced fruit, but that specimen is too poor for determination.

Sauvagesia erecta L. Sp. Pl. 203. Espirito Santo, 1891 (1216) = Rusby's 1076.

BIXINEAE.

Bixa Orellana L. Sp. Pl. 512. Espirito Santo, 1891 (1174). The white-flowered form = Rusby's 1310.

POLYGALEAE.

(Communicated by Dr. A. Chodat.)

Polygala Boliviensis A. W. Bennett, Journ. Bot. 8: (1879) 171. Vic. Cochabamba, 1891 (1010).

Polygala acuminata (Willd.) Chodat, Mon. Polyg. 2: 45. Vic. Guanai, July, 1892 (1588).

Monnina aestuans (L.) DC. Prod. 1: 338. Vic. Sorata, May, 1892 (1305).

Monnina herbacea DC. Prod. 1: 340.

Habita, forma sepalorum, appendicibus auriculariformibus, styli cum *M. macrostachya* R. et P. convenit, differt stipulis spiniformibus deficientibus, staminibus 6 (loco 8), duobus utraque parte coaliti et formam fructu (deficiens).

Vic. Sorata, May, 1892 (1309).

MONNINA RUSBYI Chodat sp. n.

Subherbacea ad 30 cm. longa, radice subsimplice; caule supra basin vel superne ramoso, ramis tenuibus ut tota planta glandulosopilosis, inde leviter rufescens. Folia linearia breviter petiolata. Racemi suproaxillares demum elongati, laxiflori. Rachis post defloriam glandulis spiniformibus remotis asperata. Flores ad 3–4 mm. longi. Sepala 3 libera lanceolata. Alae longe et distincte unguiculatae limbo late suborbiculari. Antherae in tubo staminoli sessiles vel subsessiles. Ovarium anguste ellipticum; stigma inferius biappendiculatum inde emarginatum. Fructus samaroideus, ala parva.

Ab omnibus hujus generis indumento, alis unguiculatis et forma stigmatis recedit.

Vic. Cochabamba, 1891 (1002).

VOCHYSIACEAE.

VOCHYSIA MAPIRENSIS sp. n.

Glabrous, or the peduncles, etc., sparsely puberulent; branches blackish, sub-terete; petioles 5–10 mm. long, blackish, stout and broad; blades (only the upper seen) 8–16 cm. long, 2.5–5 cm. broad, oblong-elliptical, with acute base, minutely retuse apex and entire strongly revolute margin; thick and rigid, pale, midrib strongly impressed above, very prominent and terete underneath, veins prominent both sides, especially beneath, finely and strongly reticulate, the primaries very numerous and unequal; panicles terminal and axillary, 1.5–3 dm. long including the peduncle, 2.5–5 cm. broad, the peduncle and rhachis stout; branchlets mostly 2-flowered, their stout peduncles and pedicels each about 4 mm. long; flower about 12 mm. long, exclusive of the obtuse spur which is 10 mm. long, each falcately curved, in opposite directions, the spur a little more strongly; calyx cylindrical-hemispherical with oblique mouth, 3 mm. long, 2 mm. broad, the smaller lobes semicircular or broader, unequal; larger sepal about twice the length of the corolla, ciliate; large petal 6.5 mm. long, 5 mm. broad, obovate with rounded apex, the others 5.5 mm. long, obcordate; anther about equalling the strongly clavate stigma; staminodia none; fruit not seen.

Between Guanai and Tipuani April–June, 1892 (1382). The same as Rusby's 610. Differs from *V. divergens* in form of leaf-base and spur and in the obtuse bud.

Qualea parviflora Mart. Nov. Gen. 1: 135. *pl. 81.* Between Tipuani and Guanai, Dec., 1892 (1663). The glabrate form.

CARYOPHYLLEAE.

Cerastium arvense L. Sp. Pl. 438. Near snow line, Mt. Tunari, 1891 (1036).

Drymaria cordata (L.) Willd. in R. and S. Syst. Veg. 5: 406. Turedon, 1891 (1136)=Rusby's 1182.

PORTULACEAE.

PORTULACA ELONGATA sp. n.

Densely pilose on the younger parts by the capillary divided stipules; stems ascending, much branched from the base, the branches erect or ascending, slender, 1–2.5 dm. long, irregularly angled, gray-green; stipules reduced to tufts of hair, persistent; leaves terete, obtuse, 8–12 mm. long; flowers sessile, the bud 1 cm. long; sepals nearly as long as the corolla, very broad, completely enclosing the flower except the apex, hyaline, light-purple,

adnate (or agglutinate?) to the base of the petals; corolla deep purple; capsule hyaline, 1.5 mm. broad; seeds black or blackish, muricate.

Turedon, 1891 (1140).

HYPERICINEAE.

Hypericum struthiolaefolium Juss. Ann. Mus. Par. 3: 161. *pl. 16. f. 2.* Near snow line, Mt. Tunari, 1891 (1026) = Mandon's 790.

Caopia tomentosa (R. & P.) Kuntze, Rev. Gen. Pl. 59. Vic. Sorata, Nov., 1892 (1724) = Rusby's 719.

Caopia Guyanensis (Aubl.) Kuntze, Rev. Gen. Pl. 58. Between Tipuani and Guanai, Dec., 1892 (1695) = Rusby's 722.

GUTTIFERAE.

Clusia—species apparently undescribed, and near *C. cuneata;* but I have only pistillate flowers in a young state, and the material does not warrant a description. Between Tipuani and Guanai, Dec., 1892 (1718).

TERNSTROEMIACEAE.

Norantea anomala H. B. K. Nov. Gen. 8: 218. *pl. 6. f. b.*? Espirito Santo, 1891 (1194). Mapiri, July–Aug., 1892 (1544). Because of the doubtfulness of this determination and the incompleteness of the description cited above, a complete description is here appended.

Glabrous; stems elongated, gray-brown, terete; petioles stout, 5–10 mm. long; blades 5–10 cm. long, 2–4 cm. broad, obovate, with rounded apex, cuneate base continued into the petiole and entire margin, coriaceous, above light-green, the midrib slightly elevated and veins obscure, underneath ferruginous, the midrib prominent, veins obscure, the primaries very numerous; glands rather small, in two somewhat irregular rows, the inner a little nearer to the margin than to the midrib, its glands a little larger than those of the outer row; spike (only one seen) 5.5 dm. long, the rhachis terete, very stout, loosely flowered; bracts entire, if of full size about 2 cm. long, including the pedicel which is about 1 cm. long and gradually broadened into the obovate strongly concave and slightly galeate, verrucose hood; flowers sessile, the bud globose or broader, 3 mm. in diameter; calyx whitish, about one-third as long as the red-brown corolla; petals coherent at the base, thick and dry; stamens 5, the filaments flat-

tened, very short and equally as broad, the imbricated anthers nearly circular, including the broad yellowish-white wings.

This differs from the type in texture, apex and surface of leaves, but is in other respects exactly the same. It is probably distinct and the two may form the basis of a distinct genus.

Erotium subintegrifolium Rusby, Mem. Torr. Bot. Club, 3: Part 3, 9. Mapiri, July–Aug., 1892 (1489) = 386.

Saurauja Rusbyi Britton, Bull. Torr. Bot. Club, 16: 64. Vic. Mapiri, 8000 ft. Jan., 1893 (1742) = Rusby's 482.

KIELMEYERA PANICULATA sp. n.

Glabrous; branches stout, reddish-brown, leafy; petioles 5–10 mm. long, stout, broad; blades 6–10 cm. long, 2.5–6 cm. broad, obovate with very abruptly contracted base, rounded or obscurely pointed apex and entire margin, coriaceous, pale, midrib channelled above, prominent beneath, veins slightly reticulate above, more so beneath; panicles terminal, short-peduncled, 1 dm. long, 6 cm. broad, loosely flowered, naked; pedicels proper 5 mm. long, stout, thickened above, striate; sepals 5, ovate, blunt, 5 mm. long, 3–4 mm. broad; corolla in bud broadly ovoid, minutely apiculate, when expanded 2 cm. broad, cream-colored (?); fruit not seen.

Between Tipuani and Guanai, Dec., 1892 (1731).

MARILA LAXIFLORA sp. n.

Glabrous except the pedicels, etc.; branches stout, soft, gray-brown, terete, the internodes about 4 cm. long; petioles 12–20 mm. long, becoming reflexed; blades 1–2.5 dm. long, 6–10 cm. broad, ovate-oval, with rounded base, abrupt short obtuse point and entire margin, above dark green, the midrib and 10–15 pairs of primaries slightly impressed, underneath yellowish-green, the midrib and primaries strongly prominent and terete, the secondaries connecting the latter with one another and, on the upper side with the midrib, the primaries inter-arching near the margin; racemes axillary, 1.5–2 dm. long including the peduncle, loosely flowered; rhachis and pedicels angled, minutely ferruginous-puberulent; pedicels divaricate, about 3 mm. long, stout, enlarged at base and apex; flowers campanulate; the calyx and corolla 1 cm. long, the stigma exserted to about one-third their length; sepals thick, keeled; petals delicate, the inner sub-contorted; stamens in 4 dense clusters; gland of the connective one-half as long as the anther, oblong, inflexed, light yellow with a black tip; style angled, clavate; stigma capitate, black, slightly 2-lobed; fruit immature, ascending, tipped with the slightly accrescent and glutinous stigma.

Between Tipuani and Guanai, Dec., 1892 (1648). Also collected by Pearce.

MALVACEAE.

Sida urens L. Sp. Pl. ed. 2, 963. Between Guanai and Tipuani, Apr.–June, 1892 (1446) = Rusby's 1454 and 1454a.

SIDA BAKERIANA sp. n.

Erect, stout, much branched, the branches elongated, straight, nearly horizontal, pilose, the hairs mostly yellowish; stem terete, the internodes about 3 or 4 cm. long; stipules of the stem-leaves 15–20 mm. long, 1.5 mm. broad at the base, from which they taper regularly to an acute point, 3- or 5-ribbed; petioles 6 mm. long, very stout; blades 8–13 cm. long, 2.5–5 cm. broad, regularly ovate with rounded base, acute apex and serrate margin, the teeth numerous, small, slightly irregular; thickish, pilose below, somewhat strigose above; stipules and leaves of the branches similar, but regularly smaller and slightly narrower; flowers solitary in the axils of leaves or bracts of short branchlets, the pedicels one-half the length of the calyx or more; bracteoles none; calyx 8–10 mm. long, strongly angled, cleft more than half way to the base, the lobes broadly triangular with acuminate and acute apex; petals light purple, about the length of the calyx; style-branches 10, stigmas capitate, rather large; ovary conical-ovoid; ovules pendulous; fruit not seen.

Mapiri, July–Aug., 1892 (1477).

Species near *S. achrantha*. Dedicated to Mr. Edmund Baker, who has contributed much to our knowledge of this difficult order.

SIDA GRACILIPES sp. n.

Stems numerous, erect or ascending from a long stout woody tap-root, very slender, 1.5–4 dm. long, terete, scabrous; stipules narrowly subulate, 5–7 mm. long, herbaceous; petioles 7–10 mm. long, slender; blades 2–4 cm. long, 1–2 cm. broad, ovate, tapering from the cordate base to the obtusish apex, with coarsely serrate margins, 5–7-ribbed, membranaceous, very finely silky hairy both sides, especially above; peduncles mostly exceeding the leaves, 1-flowered or bearing a second flower near the summit, slender; bracteoles none; calyx, in flower, 8 mm. long, strongly angled, cleft to below the middle, long-hirsute on the angles, the lobes acuminate, ciliate, 3–5-nerved; petals light purple, slightly exceeding the calyx; style 5-cleft; ovary spheroidal, strongly 5-lobed upon apex and sides; fruit sharply 10-beaked.

Vic. Cochabamba, 1891 (1146).

This is the same as No. 747, from La Granga, March, 1891, missed in Part 1. of my enumeration.

Wissadula rostrata (Schum. et Thoun.) Hook. Nig. Flor. 229 (*Sida rostrata* Sch. et Th. Beskr. 306). Mapiri, July–Aug., 1892 (1512).

Wissadula periplocaefolia (L.) Griseb. Cat. Pl. Cub. 25. Between Guanai and Tipuani, Apr.–June, 1892 (1411) = Rusby's 1860 and 1861.

Wissadula spicata (H. B. K.) Presl, Rel. Haenk. 2: 117. Between Guanai and Tipuani, Apr.–June, 1892 (1416) = Rusby's 1862 and 1957.

Abutilon ramiflorum A. St. Hil. Fl. Bras. Mer. 1: 199. Between Guanai and Tipuani, Apr.–June, 1892 (1451).

Pavonia paniculata Cav. Diss. 3: 135. *pl. 46. f. 2.* Mapiri, July, 1892 (1496) = Rusby's 1789.

Pavonia malacophylla (Nees et Mart.) Britton, Bull. Torr. Bot. Club, 16: 154. Between Guanai and Tipuani, Apr.–June, 1892 (1456) = Rusby's 1462.

Pavonia diuretica St. Hil. Plant. Us. *pl. 53.* A little below Cochabamba, 1891 (1053) = Rusby's 1459.

Gossypium maritimum polycarpum Todaro, Rel. Cult. Cot. *pl. 8.* Espirito Santo, 1891 (1201) = Rusby's 659.

Chorisia sp. Espirito Santo, 1891 (1175). Flowers only.

CEIBA BOLIVIENSIS Britten sp. n. Journ. Bot. Apr., 1896. Vic. Cochabamba, 1891 (1154).

Ochroma Lagopus Swz. Fl. Ind. Occ. 2: 1144. Mapiri, July–Aug., 1892 (1501) = Rusby's 1927.

STERCULIACEAE.

Helicteres Barnensis Jacq. Amer. 236. *pl. 147.* Between Guanai and Tipuani, Apr.–June, 1892. (1362 and 1401.) The same form collected by Pearce in Scarlet Valley, below Coroico.

Waltheria Americana L. Sp. Pl. 673. Between Guanai and Tipuani, Apr.–June, 1892 (1418) = Rusby's 1405 and 1458.

CHAETAEA LANCEOLATA (Sesse).

Buettneria lanceolata Sesse; DC. Prod. 1: 487. Between Guanai and Tipuani, Apr.–June, 1892 (1369).

TILIACEAE.

Triumfetta semitriloba L. Mant. 1: 173. Vic. Guanai, July, 1892 (1597) = Rusby's 715, 718, 1236a and 1450.

Triumfetta grandiflora Vahl, Ecl. 2: 34. Mapiri, July–Aug., 1892 (1499).

Heliocarpus Americanus L. Sp. Pl. 448. Between Guanai and Tipuani, Apr.–June, 1892 (1455) = Rusby's 1492 and 1493.

Heliocarpus Popayannensis H. B. K. Nov. Gen. 5: 341. Mapiri, July–Aug., 1892 (1491).

LUEHEA SPLENDENS sp. n.

Branches and branchlets very stout, the latter 3 mm. or more in diameter, ferruginous-tomentellate; stipules 2 cm. long, 8 mm. broad, inequilaterally ovate from the base, obtusish, coriaceous, velvety, many-nerved or costate; petioles very stout, about 2 cm. long; blades 1–3 dm. long, 5–15 cm. broad, ovate to obovate with inequilateral cordate base, short-acuminate and acute apex, and sharply serrate-dentate margin, the sinuses rounded; coriaceous, above dark green and very minutely cinereous, the midrib and 8 or 10 pairs of primaries slightly prominent, the former slightly channelled, underneath densely ferruginous-tomentellate, the veins very prominent, the secondaries connecting the primaries and rather crooked; flowers racemose-paniculate at the summit and solitary in the upper axils, rather few; pedicels 1–2 cm. long, 5 mm. broad, terete or subquadrilateral; bracteoles 5 (dividing when older?), valvate, two-thirds the length of the sepals and as long as the petals, acute, coriaceous, densely ferruginous-tomentose without and pinkish-velvety within; sepals 5, valvate, 6 cm. long, lanceolate, coriaceous, densely ferruginous-tomentose without, within crimson, 7–9-nerved, glabrous except the midrib and margins, which are silky-pilose toward the base; petals imbricate, crimson, membranaceous, strongly nerved, obovate, short-acuminate and very acute, entire, the base somewhat narrowed, each bearing about 5 partly coherent, thick glands nearly 5 mm. in length, at the base on the inner side; stamens very numerous, equalling the sepals, the outer somewhat shorter and anantherous, collected in 5 phalanges, white-villous or pubescent at the base; ovary oblong-ovoid, 5-angled, 2 cm. long, ferruginous; style very stout, equalling the sepals, thickened at the apex; stigma capitate, 8 mm. broad; fruit oblong, inequilateral and slightly falcate, strongly 5-lobed (dehiscence?), apparently not mature; seeds strongly imbricate, the oblong apical wing 4 or 5 times as long as the angular body.

Between Guanai and Tipuani, April–June, 1892 (1339).

Collected also by Pearce below Coroico. Fendler's no. 1915, from Trinidad, lacks the cordate leaf-base and has a shorter fruit.

Apeiba Tibourba Aubl. Pl. Guian. 1: 538. Between Tipuani and Guanai, Dec., 1892 (1701) = Rusby's 613 and Gardner's 1476x.

Apeiba membranacea Spruce; Benth. Journ. Linn. Soc. 5: Supp. 61. Between Tipuani and Guanai, Dec., 1892 (1703) = Rusby's 612.

Prockia completa Hook. Ic. Pl. 1: *pl. 94*. Guanai, Dec., 1892 (1633) = Rusby's 1491.

Vallea stipularis Mutis; L. f. Supp. 266. Near snow-line, Mt. Tunari, 1891 (1112).

LINEAE.

ERYTHROXYLON PAUCIFLORUM sp. n.

Glabrous; branches slender, gray-brown; stipules 5–7 mm. long, triangular-subulate, very acute, membranaceous, brown; petioles 3 mm. long, stout; blades 6–12 cm. long, 3–7 cm. broad, regularly oval, obtuse, entire, thickish, veins obscure above, the midrib and 12–15 irregular pairs of primaries slightly prominent beneath; flowers not seen; fruiting pedicels sheathed at the base by 5–7 bracts similar to the stipules, but shorter, the pedicels 5–8 mm. long, upwardly thickened, strongly and sharply angled; calyx 3–4 mm. broad, the sepals very broadly obovate, strongly apiculate, striate; fruit blackish, oblong, 7–8 mm. long, 4 mm. broad, tipped with the persistent styles.

Between Tipuani and Guanai, Dec., 1892 (1639).

MALPIGHIACEAE.

BYRSONIMA BIACUMINATA sp. n.

Arborescent, the branchlets slender, striate, the younger channelled and ferruginous; stipules entire, thickish, broadly ovate, obtuse, concave, gray-tomentose without, bright brown within, about 2 mm. long and broad; leaves attenuate into a short petiole, 6–12 cm. long, 1.5–3 cm. broad, oblong, about equally acuminate at both ends, obtusish or barely acute, thick reticulate and shining above, beneath compactly ferruginous-tomentose; racemes rather dense, ovoid-oblong, 3 cm. long by 2 cm. broad, on peduncles 1.5–2 cm. long; bracts small, ovate, like the peduncles, etc., ferruginous; pedicels about 8 mm. long, grooved, recurved; bud broadly ovoid with rounded apex; petals 6 mm. long; glands white and shining; anthers 2 mm. long, brown; fruit not seen.

Tipuani, Dec., 1892 (1643). Also collected by Pearce at Yungas. Species near *B. spicata*.

STIGMATOPHYLLON COLORATUM sp. n.

Stems strongly twining, slender, slightly channeled, pubescent, some of the hairs retrorse; leaves of the pair nearly equal; petioles 2.5–8 cm. long, rather stout, pubescent, the blackish broadly spheroidal closely sessile glands near the summit; blade 5–15 cm. long, 4–12 cm. broad, regularly cordate-ovate, with nearly closed sinus, with very abrupt slight acute apical prolongation, and obscurely denticulate margin, the veins with short aristiform prolongations; glabrous both sides, bright green above, rich purple underneath, except for the green margins; primaries about 8 pairs, slender, rather crooked, prominent underneath, connected by the secondaries and forked-reticulate near the margin; peduncles axillary, 4–8 cm. long, slender, pubescent, 2–4-angled, compressed at the summit, about 20-flowered, bearing among the pedicels several glands like those of the petioles; pedicels very unequal, many times shorter than the peduncles; bud obovoid, with a broad summit; calyx hemispherical, 5 mm. broad, the sepals broadly ovate with rounded summit, the blackish glands oblong, appressed, two-thirds the length of the calyx, petals 12–15 mm. long; stigmatic appendage conspicuous, green, puberulent; samaras (in my specimen) 1–3, 2.5–3.5 cm. long, about 13 mm. broad at the base, the wing abruptly contracted at the back, near the base, to 1 cm., the apex blunt or rounded, the ventral margin irregularly sinuate above, the surface sparsely gray-pilose, finely very many nerved.

Between Guanai and Tipuani, Apr.–June, 1892 (1366).

Bannisteria sp., near *B. argentea* (H. B. K.) Spreng., but in bud only. Between Guanai and Tipuani, Apr.–June, 1892 (1365).

Bannisteria, apparently an undescribed species intermediate between *B. Martiana* and *B. lucida*, but fruit is lacking.

Mapiri, July–Aug., 1892 (1531).

Tetrapterys papyracea Tr. & Pl. Ann. Sci. Nat. (IV) 18: 334. Between Guanai and Tipuani, Apr.–June, 1892 (1356).=Rusby's 513 but not 731.

Tetrapterys calophylla A. Juss. Monog. Malpigh. 271. Var. (?) BOLIVIANA. n. var.

The younger portions puberulent or canescent; branchlets reddish, stout, the internodes 5–7 cm. long; petioles 1–1.5 cm. long, stout; blades 1–1.5 dm. long, 5–8 cm. broad, oval-obovate, the base subcordate and mostly inequilateral, the apex with a very short blunt point, revolute, thin but rigid, somewhat shining on both sides, sparsely pubescent on the veins beneath, the primaries 5 or 6 pairs, strongly falcate-ascending, connected by the numerous slender crooked secondaries, the reticulation elongated and rather coarse; panicles axillary and terminal, sessile or short-pe-

duncled, leafy, the floral leaves mostly more than 1 cm. long, oval-orbicular, wavy, emarginate, sessile; pedicels 3–5 mm. long, 2-bracted, a gland between the bracts on one side; calyx cup-shaped, 7 or 8 mm. broad; the sepals white, fleshy, entire, broadly oval with rounded apex, strongly appressed to the stamens and two-thirds of their length; glands 8, large, oblong; petals 7 mm. long, strongly clawed and concave, entire; stamens 10, anthers uniform, the filaments a little more than 3 mm. long, the alternate longer, lanceolate, outwardly arched above the base, connivent above and the apices again curved outward; anthers 1 mm. long, not appendaged; ovary densely pilose, the gynobase very slightly pyramidal-elevated; ovaries 3, the cristae low, obtuse; styles stout, a little exceeding the stamens; stigmas oval, oblique, green, 1 mm. long; fruit not seen.

Between Guanai and Tipuani, April–June, 1892 (1338).

Apparently the same as Rusby's, No. 731, but not 513.

Hiraea chlorocarpa A. Juss. Ann. Sci. Nat. (II) 13: 259. Espirito Santo, 1891 (1192).

ZYGOPHYLLEAE.

PORLIERA ARIDA sp. n.

Fructicose, divaricately much branched, the branchlets short and stout, some of them spinose, blackish, the youngest tomentellate and grayish; spines (stipules) of variable length, about 1 mm. long, stout, rigid, pungent, spreading; leaves papillose-glandular, light green, about 1 cm. long on a very short petiole, rhachis stoutish, the leaflets about 9 pairs, sessile, 2 to 3 mm. long by 0.6 mm. broad, oblong or slightly broader near the rounded apex, thick and coriaceous; flowers not seen; fruiting peduncle 5 to 7 mm. long, clavate; fruit obcordate, 2-celled (always?), 5 mm. long by 8 mm. broad, blackish.

Turedon, 1891 (1124).

Very near *P. hygrometrica* R. and P., but differs in form of leaflets and of fruit. Mandon's no. 861 with about 15 pairs of narrower leaflets, 7 mm. in length, shining above, and with fruit almost identical with *P. arida*, is quite distinct and is apparently undescribed.

GERANIACEAE.

Tropaeolum tuberosum R. and P. Fl. Per. 3: *pl. 314.* Vic. Cochabamba, 1891 (Cult.) (1102)=789.

TROPAEOLUM MACULATUM sp. n.

Glabrous; stems very slender, the internodes about 5 cm. long; petioles slender, nearly 1 dm. in length; stipules none; leaves

3–8 cm. broad, 2–5 cm. long, the basal margin sub-truncate, the remainder divided one-third of the way to the petiole into five lobes which are roundish-quadrilateral and obscurely sinuate, separated by narrowly ovate obtuse or rounded sinuses, veins 7 to 9, slender; pedicels solitary, in flower about 8 cm. long; flower about 2 cm. long, yellow or light scarlet with large deep indigo spot and a light scarlet stout spur 1 cm. long.

Vic. Cochabamba, 1891 (1066).

Hypseocharis pimpinellifolia Remy, Ann. Sci. Nat. (III.) **8**: 238. Near snow-line, Mt. Tunari, 1891 (1043) = Rusby's 2553.

Oxalis tuberosa Mol. Stor. Nat. Chil. 132. Turedon, 1891. Cult. as "Oca." (1104).

Oxalis filiformis H.B.K. Nov. Gen. 5: 245. *pl. 469.* Near snow-line, Mt. Tunari, 1891 (1037) = Mandon's 847.

Oxalis dendroides H. B. K. Nov. Gen. 5: 250. Between Guanai and Tipuani, Apr.–June, 1892 (1397) = Rusby's 856 and 1752.

OXALIS ERYTHROPODA sp. n.

Stems erect or ascending, straight, stout, simple, red or purple at least at the base, puberulent; internodes very unequal, mostly 1–2 cm. long; petioles 2.5–3.5 cm. long, slender, strongly ascending, pubescent; leaflets 3, the lateral petiolules 1 or 2 mm., the terminal 4 or 5 mm. long; leaflets 2–3 cm. long, 1–2 cm. broad, the lateral oval or slightly obovate, with rotund apex and subrotund base, the terminal obovate with cuneate base and subtruncate slightly retuse apex, all very thin, densely sericeo-pubescent and pale underneath, less sericeous above; peduncles solitary in the axils, 5–7 cm. long, otherwise similar to the petioles, the (about 10) flowers umbelled or capitate at the summit; pedicels mostly present, at most 3 or 4 mm. long; flowers bright yellow, about 8 mm. long; calyx one-half as long as the corolla, the sepals ovate, tapering, acute; capsule nearly or quite 1 cm. long, two-thirds as broad, turgid, ovoid, with truncate broad base and broad apex, tipped by the purple styles 1 mm. long, and enclosed for two-thirds of its length by the accrescent calyx; seed 2.5 mm. long, oval-ovoid, short-beaked, light brown, coarsely reddish muricate.

Vic. Guanai, July, 1892 (1598). Near *O. Sepium*.

RUTACEAE.

Erythrochiton Brasiliense Nees et Mart. Nov. Act. Cur. 11: 166. Between Guanai and Tipuani, Apr.–June, 1892 (1367)=Rusby's 2615.

Citrus acida Roxb. Fl. Ind. 3: 390. Vic. Guanai (naturalized) 1892 (1611).

Benjamina Peruviana (Planch.) Kuntze, Rev. Gen. Pl. 103. (*Dictyoloma Peruviana* Planch. in Hook. Lond. Jour. Bot. 5: 583). Between Guanai and Tipuani, Apr.–June, 1892 (1385) = Rusby's 738 and Spruce's 3888.

OCHNACEAE.

CESPEDESIA EXCELSA sp. n.

Glabrous, arborescent, the branchlets stout, terete; stipules 6–8 cm. long, 1 cm. broad, oblong-spatulate with rounded apex, the margin above slightly crumpled-crenate; petioles .75–1 dm. long, 8 mm. broad, semi-cylindrical, the upper side hollow with very acute edges; blades 5–7.5 dm. long, 2–2.5 dm. broad, obovate-spatulate with regularly rounded apex, sinuate-serrate, the very small teeth strongly inflexed, scarcely mucronate; coriaceous, rigid, the primaries 35 to 45 pairs, parallel, straight, connected by very numerous straight secondaries which meet at about the middle point; panicle 2.5–3 dm. long, exclusive of the stout peduncle, which is two-thirds as long, sparsely branched, and few-flowered; pedicels 1 cm. long, stout; calyx saucer-shaped, about 7 mm. broad, mostly lobed to about the middle, the lobes broad and rounded, the tube lightly costate; bud 1.25–1.5 cm. long, slightly and obtusely pointed; petals deep yellow, broadly obovate with rounded crumpled margin, thick; stamens shorter than the corolla, pistil a little longer, the ovary slightly falcate; fruit not seen.

Between Tipuani and Guanai, Dec., 1892 (1723). Distributed as 1658 or 1658a.

MELIACEAE.

GUAREA RUSBYI (Britton). (*Sycocarpus Rusbyi* Britton, Bull. Torr. Bot. Club, 14: 143).

Since referred to *G. trichilioides* L., but the latter species is really a West Indian shrub. Specimens of *Guarea* in herbaria are very badly named, and the limits of the species are difficult to trace. This species is nearest to *G. Aubletii*, but differs especially in the denseness and stoutness of the more compound inflorescence, the shorter and broader bud, and the deeper thicker more wooly, erect calyx, which closely clasps the base of the corolla. It appears intermediate between *G. Aubletii* and *G. purgans*.

Between Guanai and Tipuani, Apr.–June, 1892 (1373) = Rusby's 463 and 1296.

MOSCHOXYLON PACHYPODUM sp. n.

Flowering branchlets very thick, tomentose; petioles 4 or 5

cm. long, a little shorter than the internodes of the rhachis; leaflets about 9, the upper, except perhaps the terminal, successively larger, imperfectly opposite, on stout petiolules 3 or 4 mm. in length, .5–1.5 dm. long, 3–7 cm. broad, oblanceolate, with rounded or blunt base and abruptly short-pointed and obtuse apex, entire, revolute, coriaceous, glabrous above with pubescent midrib and slightly impressed primaries (16 to 20 pairs), underneath downy on the veins; panicles terminal, irregularly much branched, short and broad; buds globose-ovoid, obtuse, 2.5–3 mm. long; calyx nearly plane, 2.5–3 mm. broad, divided midway; petals purplish-red, 3.5 mm. long; fruit not seen.

Between Guanai and Tipuani, Apr.–June, 1892 (1454).

MOSCHOXYLON VIRIDE sp. n.

Branches stoutish, grayish-red, terete; petioles (the upper) 3–5 cm. long, the internodes of the rhachis a little shorter; leaflets 7, the upper successively larger, 6–12 cm. long, 3–5 cm. broad, obovate, the cuneate base tapering into a very short petiole, and, especially the uppermost, inserted into a dilated portion of the rhachis, the apex abruptly contracted into a short broad obtuse point; entire, membranaceous, bright green, glabrous on both sides, venation slender, the primaries about 10 or 12 pairs; panicles solitary in the axils and terminal, about 1 dm. long exclusive of the long or short peduncle, pyramidal, lax; flowers not seen; fruiting pedicels 3–5 mm. long and like the branches of the panicle, slightly cinereous; calyx plane, 3 mm. broad, lobed to the middle; fruit (mature?) ellipsoidal, 8 or 9 mm. long, 6 mm. broad, tomentose, yellowish, bluntly triangular, the sides lightly grooved, imperfectly 3-celled through the abortion of all but one ovule.

Between Guanai and Tipuani, Apr.–June, 1892 (1370).

Possibly a *Trichilia*, though the habit is that of *Moschoxylon*. It is apparently near *M. gracile*.

OLACINEAE.

HEISTERIA BIFLORA sp. n.

Glabrous; branches slender, strongly ascending, slightly angled, the internodes 2.5–3 cm. long; petioles half as long as the internodes; blades .7–1 dm. long, 3–4 cm. broad, oblong, the base cuneate, the apex abruptly short- and blunt-pointed; dark green, coriaceous but not thick, the venation indistinct, strongly reticulate, the primaries about 15 pairs, communicating very near the margin; pedicels geminate, 4 mm. long; flowering calyx saucer-shaped, 2.5 mm. broad, divided half-way to the base, the lobes triangular, acute; petals 3 mm. long, ovate-oval, acutish;

stamens 10, shorter than the petals, the alternate ones longer, the filaments flattened, pilose; ovary broad, 5-lobed; style stout, conical-cylindraceous; fruiting calyx 1.5–2 cm. broad; fruit 1 cm. long, spheroidal, light-brown, coarsely many-striate.

Between Guanai and Tipuani, Apr.–June, 1892 (1407).

Heisteria—species probably undescribed, but farther comparison is required. Between Tipuani and Guanai, Dec., 1892 (1677).

Schoepfia obliquifolia Turcz. Bull. Soc. Imp. Nat. Mosc. 31: Part 1, (1858) 249. Guanai–Tipuani, Apr.–June, 1892 (1409).

DENDROBANGIA gen. nov.

Flowers perfect; calyx 5-parted, the segments coherent at the base, imbricated, unequal, the outer larger; petals 5, coriaceous, valvate, the apices inflexed and bearing bearded appendages, which in the bud are entangled with the anthers, in anthesis strongly recurved; stamens 5 and alternate, or 10, the filaments naked, dilated at the base, adnate to the corolla-tube, the anthers short, 2-celled, cells connected only at the point of attachment to the filament, not appendaged; disk none or inconspicuous; ovary compressed, inequilateral, 1-or (mostly) 2-ovuled, the ovules pendulous; stigma minute, nearly sessile, situated unilaterally; fruit not seen.

A tree, with alternate exstipulate coriaceous leaves, and nodal and intranodal inflorescence, the flowers sessile and crowded at the ends of the short branchlets of the small clustered panicles; bracts and bracteoles present.

Although in its calyx-characters this genus is related to *Villaresia*, its corolla is in all its general features like that of *Poraqueiba* or *Emmotum*.

I am indebted to Mr. Oliver for having kindly pointed out the affinities of the plant.

DENDROBANGIA BOLIVIANA sp. n.

Branchlets stoutish, terete, glabrate, the internodes 1–1.5 cm. long; petioles .5–1 cm. long, very stout; blades .75–1.5 dm. long, 4–5 cm. broad, obovate, the base obtuse, the apex abruptly short-pointed, acutish; entire, rigid, dark green, glabrous, venation inconspicuous, the primaries about 6 pairs, strongly falcate-ascending, somewhat crooked; panicles 2 or 3 cm. long, loose, granular-scurfy; the bracts ovate, 2 mm. long, thick and rigid, gray, the bracteoles similar, closely appressed to the calyx; calyx thick and coriaceous, the sepals lightly imbricated, nearly 2 mm. long, ovate, the margins lighter colored; corolla dark purple, 3 mm. long, broadly campanulate, lobed two-thirds of the way to the base, the ovate acute lobes strongly recurved, the appendages oblanceolate,

densely bearded; stamens about half as long as the corolla-lobes, exclusive of their appendages.

Between Tipuani and Guanai, Dec., 1892 (1694).

ILICINEAE.

ILEX AMPLIFOLIA sp. n.

Glabrous; branches stout, much wrinkled in drying, light gray-brown; petioles very broad and stout, 1–1.5 cm. long; blades .75–1.5 dm. long, 4–8 cm. broad, oval-elliptical or the base slightly produced, the margin obsoletely serrate, and slightly revolute, coriaceous and very thick, dark-green or the older pale; on the upper surface midrib broad, slightly prominent, longitudinally wrinkled, veins inconspicuous; underneath the very stout midrib and 10–12 non-opposite primaries very prominent, the latter forked and anastomosing near the margin; bracts light brown, 3–4 mm. long, broadly ovate, acuminate and acute, sheathing the base of the peduncle, the bractlets similar but smaller; peduncles proceeding irregularly from the upper internodes, about 2 cm. long, slender, blackish, bearing 3–5 umbels on secondary peduncles less than half as long; umbels about 5–10-flowered, occasionally compound, the pedicels 3–4 mm. long; buds globose, about 3 mm. in diameter, rather loosely seated in the calyx, which is crateriform and very slightly lobed, the lobes broad and rounded; petals 3–3.5 mm. long and broad, white, thickish; fruit not seen.

Between Tipuani and Guanai, Dec., 1892 (1682).

Very near *I. crassifolia* and perhaps the same as Lechler's no. 2624.

CELASTRINEAE.

MAYTENUS FLAGELLATA sp. n.

Glabrous, much branched, the branches and branchlets elongated and very slender, the former gray-brown, the latter green and sharply angled or narrowly winged, very leafy, the internodes about half the length of their leaves; leaves subsessile, 1.5–3 cm. long, 2–4 mm. broad, oblong-oblanceolate with tapering base and acutish or abruptly pointed apex, faintly serrate with brownish cartilaginous teeth, thick and rigid, pale green, the midrib and about 6 pairs of ascending primaries rather prominent on both sides; flowers sessile, mostly geminate, greenish-yellow with purple center, 4 mm. in diameter; fruit globose-pyriform, 7–8 mm. long, light brown, 2-carpelled.

Turedon, 1891 (1128).

RHAMNEAE.

Gouania Blanchetiana Miq. Linnaea, 22: (1849) 797. (*G. sepiaria* Mart. ex Britt. Bull. Torr. Bot. Club, 16: 189.) Espirito Santo, 1891 (1187). = Rusby's 1486.

Gouania tomentosa Jacq. Amer. 263. Espirito Santo, 1891 (1270) = Rusby's 1758.

AMPELIDEAE.

Vitis sicyoides canescens (Lam.) Baker, in Mart. Fl. Bras. 14: Part 2, 202. Espirito Santo, 1892 (1265) = 321.

Vitis ovata (Lam.) Baker, in Mart. Fl. Bras. 14: Part 2, 203. Between Guanai and Tipuani, Apr.–June, 1892 (1389) = Rusby's 2087.

SAPINDACEAE.

Determined by Dr. L. Radlkofer.

Serjania sufferruginea Radlk. Mon. Sap. 299. Espirito Santo, 1891 (1258).

Serjania leptocarpa Radlk. Mon. Sap. 112. Espirito Santo, 1891 (1262).

Serjania meridionalis Camb. in St. Hil. Fl. Bras. 1: 366. *pl.* 76. Espirito Santo, 1891 (1266a).

Serjania marginata Casar. Decad. Stirp. Nov. Bras. 5: 44. Vic. Mapiri, 12,000 ft., Sept, 1892 (1587). Ad forma *S. pluridentata* Radlk., foliis depauperatis = Rusby's 525.

Serjania Mansiana Mart. Flora 23: (1839) in Bibliog. 1, 9. Vic. Mapiri, 8,000 ft., Sept., 1892 (1583).

Serjania confertiflora Radlk. Serj. Monogr. 117; Suppl. 89, 162; Fl. Bras. fasc. 113, 262) Var. DASYCEPHALA Radlk. Fructus (juvenilis) truncatus, puberulus, loculis subcristatis dense rufidulo-pubescentibus; foliola punctis lineolisque pellucidis nervis lateralibus parallelis undulato-flexuosis eleganter notata. Espirito Santo, 1891 (1262a). Between Guanai and Tipuani, Apr.–June, 1892 (1357, flor.)=Rusby's n. 1754 (flor. et fruct. juvenil.) and Bang's 421a.

Serjania dumicola Radlk. Conspect. Serj. 4. Between Guanai and Tipuani, Apr.–June, 1892 (1450).

Allophylus punctatus (Poepp.) Radlk. (*Schmidelia punctata* Poepp. Nov. Gen. 3: 38. *pl. 244*). Mapiri, July–Aug., 1892 (1520).

Allophylus petiolulatus Radlk. Erganzungen Mon. Sap. 181. Between Tipuani and Guanai, Dec., 1892 (1638). = Rusby's 2086.

ANACARDIACEAE.

Quebrachia Lorentzii Griseb. Symb. Bot. Fl. Arg. 95? Turedon, 1891 (1129). Presents differences in foliage and size of flowers from the type, but fruit is lacking.

TAPIRIRA PEARCEI sp. n.

Branches stout, brown, hoary, striate; petioles 6–10 cm. long, stout, striate, glabrate, the internodes of the rhachis about half as long; leaflets 7–9, the upper larger; the petiolules .5–1 cm. long, stout; leaflets .8–1.5 dm. long, 3–5 cm. broad, narrowly ovate, with subrotund but highly unequal base and acuminate apex, coriaceous, dark-green above, ferruginous but glabrous underneath, midrib prominent both sides, strongly so below, like the 10 to 15 pairs of primaries; panicles fascicled at the summit, 2–3 dm. long, decompound, lax, open and sparsely flowered; bracts subulate, twice the length of the pedicels; flowers very shortly and stoutly pedicelled; calyx 2 mm. broad, deeply lobed; petals twice the length of the calyx, white, oblong-obovate; fruit not seen, except as stated below.

Vic. Mapiri, July–Aug., 1892 (1543). Collected also by Pearce at Sandillani and Chailla. His specimens show fruit blackish, broadly ovoid, obliquely truncate, granular, 11 mm. long, 6 mm. broad.

LEGUMINOSÆ.

Crotalaria Pohliana Benth. Tayl. Ann. Nat. Hist. 3: 428. Between Guanai and Tipuani, Apr.–June, 1892 (1442)=Rusby's 580.

Indigofera Anil L. Mant. 272. Guanai, Apr.–June, 1892 (1460).

Barbiera polyphylla DC. Mem. Leg. 242. Between Guanai and Tipuani, Apr.–June, 1892 (1363) = Rusby's 2356.

GLIRICIDIA MICHELII sp. n.

Apparently a climbing or reclining shrub, the younger growth puberulent; branches much elongated and slender, coarsely angled, glabrous, the internodes unequal, mostly about 8 cm. long; stipules lanceolate or subulate, 3 mm. long; petioles 1–1.5 cm. long, angled, internodes of the rhachis nearly 1 cm. long, stipellae none; leaflets about 7 or 8 pairs, on very short petiolules, 1.5–3 cm. long, .8–1.5 cm. broad, slightly inequilateral, oblong-ovate, the base rounded, the apex blunt and minutely cuspidate, entire; lightly revolute, membranaceous, bright-green, minutely black-dotted un-

derneath, finely reticulate, the primaries about 8 on each side, not opposite, crooked; racemes axillary, in reality solitary but appearing as though 2–3-fascicled, 8–10 cm. long inclusive of the peduncle, which is 1–2 cm. long, interrupted, the flowers mostly 2 or 4 together, the bracts similar to the stipules; calyx broadly campanulate, 4 mm. long and broad, divided about one-third of the way to the base; corolla purple, exceeding the calyx by 5 or 6 mm.; vexillum indistinctly auricled; style naked; youngest legumes only seen, apparently coriaceous, about 5-seeded.

Vic. Sorata, Nov., 1892 (1621). Kindly determined by M. Micheli.

Astragalus Mandoni Rusby, Mem. Torr. Bot. Club, 3: Part 3, 19. Near snow-line, Mt. Tunari, 1891 (1022).

Chaetocalyx Brasiliense (Vogel) Benth. in Mart. Fl. Bras. 15: Part 1, 75. Between Guanai and Tipuani, Apr.–June, 1892 (1348) = Rusby's 2398.

AMICIA PARVULA sp. n.

Herbaceous, the stems much elongated, very slender, only the younger portions minutely puberulent, purplish below, terete, the internodes 3 or 4 cm. long; stipules withering-persistent, broadly sheathing, somewhat decurrent, about 5 mm. long; petioles filiform, 1–2.5 cm. long; leaflets 2 pairs, subsessile, about 1 cm. long and broad, triangular, obcordate, the lobes entire, rounded, the large sinus (about 90°) varying from acute to rounded, very sparsely pubescent and rather sparsely beset below with rather large brown glands; racemes solitary in the axils and terminal-panicled, the peduncles 1–2 cm. long, filiform but rigid, erect-spreading, the flowers about .75–1 cm. apart, their bracts 2 mm. long, 1 mm. broad, obovate with rounded apex, herbaceous, the pedicels 5–7 mm. long, filiform; calyx about 8 mm. long, strongly nerved, pubescent, sparsely beset with large bright red glands, the tube 2 mm. long, campanulate, the upper lobes 5 or 6 mm. long, 2 mm. broad, obovate with short-acuminate and obtuse point, the lateral lobes 3 mm. long, oblong, obtuse, the lower lobe nearly equalling the upper, broader, folded to form a keel; petals subequal; vexillum 8 mm. long, 6 mm. broad, obovate, scarcely emarginate; alae 8 mm. long, slightly oblique, obtuse, free, auricled; stamens 9 mm. long, monadelphous, the sheath cleft upon the upper side, the anthers uniform; style slightly exceeding the stamens, the apex recurved, the stigma ovoid, oblique; ovary sessile, 3 mm. long, 4- or 5-ovuled; fruit about 1 cm. long, 3 mm. broad, 4- or 5-seeded, both sutures intruded, the lower more deeply; segments circulo-quadrilateral, the margin thickened and wavy or tuberculate, 2-winged upon the inferior side along the

middle portion, thickened, crenate; pericarp cartilaginous, thickened; seed 2 mm. long, strongly reniform, moderately flattened, smooth.

Vic. Cochabamba, 1891 (1068). It is possible that when the fruit and seed characters of *Amicia* are better known, it will be found that this is generically distinct.

PATAGONIUM GRANDIDENTATUM sp. n.

Hoary-pubescent; root vertical, stout; stems numerous from a perennial crown, ascending, elongated, slender, sparingly branched, the branches similar; stipules 2–3 mm. long, two-thirds as broad, inequilateral, ovate, acute or acuminate; leaves conspicuously but unequally petioled, bearing mostly about 10 leaflets on each side, these unequally distributed but approximately about the length of their internodes; leaflets subsessile, 5–7 mm. long, 3–5 mm. broad, obovate, or the larger inclining to truncate and triangular-obovate, about 8-toothed, the teeth large and rounded with acute sinuses, thick, the venation obscure and impressed above; racemes terminal, the lowest flowers in the axils of small leaves; bracts similar to the stipules; pedicels about as long as the flowers, 5 mm. or in fruit about a half longer; legume (exclusive of pedicel and beak) about 2 cm. long, 3.5 mm. broad, tipped with a subulate or filiform beak of variable length, of about 7 joints, beset with small dark green glands; sinuses of the articulations extending less than half way across; seed rich brown, lenticular, one-half to two-thirds as broad as the legume.

Vic. Cochabamba, 1891 (1012).

Stylosanthes Guyanensis subviscosa Benth. in Mart. Fl. Bras, 15: Part 1, 192. Between Guanai and Tipuani, Apr.–June, 1892 (1459). Determined by Dr. P. Taubert.

Meibomia cajanaefolia (DC.) Kuntze, Rev. Gen. Pl. 195. Guanai, Apr.–June, 1892 (1417) = Rusby's 964.

Lathyrus pubescens H. and A. Bot. Beech. 21. Near snow-line, Mt. Tunari, 1891 (1023) = Rusby's 1011.

Bradburia Plumiera (Turp.) Kuntze, Rev. Gen. Pl. 164. (*Centrosema Plumiera* Turp. Ann. Mus. Vind. 2: 110.) Espirito Santo, 1891 (1273).

Erythrina rubinervia H. B. K. Nov. Gen. 6: 434. Mapiri, July–Aug., 1892 (1515).

Styzolobium rostratum (Benth.) Kuntze, Rev. Gen. Pl. 208 (*Mucuna rostrata* Benth. in Mart. Fl. Bras. 15: Part 1, 171.) Vic. Guanai, July, 1892 (1599.)

No. 1257 is also apparently a form of the same species.

Stizolobium ellipticum Pers. Syn. 2: 299. Between Guanai and Tipuani, Apr.–June, 1892 (1353).

STIZOLOBIUM MAPIRENSE sp. n.

Sparingly ferruginous-pubescent throughout, except the gray-tomentose calyx; stems very slender, the internodes 3–5 dm. long or more; petioles 5–7 cm., rhachis 1.5–2 cm., and petiolules 1 cm. long, the last thickened, blackish; lateral leaflets 1–1.5 dm. long, 6–8 cm. broad, the lower lateral half about twice the breadth of the upper, ovate, the base rounded or inclined to cordate, the apex abruptly and very slenderly acuminate; entire, very thin, dark, sparingly strigose; terminal leaflet nearly a half longer, very little broader, obovate-oval, the base slightly contracted, otherwise similar; venation reticulate, inconspicuous, very slender, yellowish; peduncles very slender, nearly a meter long, thickened toward the panicle; pedicels flattened, 2–4 cm. long; bud ellipsoidal; calyx campanulate, 2 cm. long and nearly 3 cm. broad at the oblique mouth, the teeth short and broad, the longest 1 cm. long; vexillum 3 cm., the other petals 4 cm. longer than the calyx, the keel barely exceeding the wings, not beaked, obtuse or scarcely acute, with a yellowish apex, the apices of keel and standard separated by 3–3.5 cm.; fruit not seen.

Between Guanai and Tipuani, Apr.–June, 1892 (1413).

Calopogonium galactioides Benth. ex. Hemsl. Biol. Cent. Am. 1: 301. Espirito Santo, 1891 (1276) = Fendler's 274.

Calopogonium coeruleum (Benth.) Britt. Bull. Torr. Bot. Club, 16: 262. Between Guanai and Tipuani, Apr.–June, 1892 (1452).

DIOCLEA PAUCIFLORA sp. n.

Branchlets, petioles, rhachis and pedicels harshly puberulent; petioles .6 to 1 dm. long, the rhachis 2–3 cm. long; petiolules 5–8 mm. long, stout; lateral leaflets .75–1 dm. long, 5–8 cm, broad, oval-ovate, slightly inequilateral, the base rounded, the apex abruptly short-acuminate and obtusish; entire, scarcely revolute, thin and membranaceous, pale, glabrous, primaries 5–7 pairs, not opposite, slightly prominent and slender, the veins finely reticulate; terminal leaflet oval-obovate, otherwise similar; panicles about 3 dm. long, peduncled, very loosely flowered, narrow and raceme-like, the branches 3–5 mm. long, very stout, at length about 10-flowered; pedicels about 3 mm. long, slender, 2-bracted at the summit, the bracts broadly ovate and acuminate, 1.5 mm. long, clasping the calyx; calyx campanulate, 1 cm. long, the lower lobe 4 mm. long; corolla nearly thrice the length of the calyx, the keel not rostrate, light purple; anthers uniform; fruit not seen.

Espirito Santo, 1891 (1190.)

Dioclea reflexa (L.) DC. Prod. 3: 404. Espirito Santo, 1891 (1272) = Rusby's 1328, 2368 and 2858.

Dolichos Lablab L. Sp. Pl. 725. Espirito Santo, 1891 (1274).

Phaseolus prostratus Benth. in Mart. Fl. Bras. 15: Part 1, 192. A little below Cochabamba (1011).

Pachyrrhizus tuberosus (Lam.) Spreng. Syst. 4: Cur. Post. 281. Between Guanai and Tipuani, Apr.–June, 1892 (1430).

Rhynchosia minima (L.) DC. Prod. 2: 385. Between Guanai and Tipuani, Apr.–June, 1892 (1433).

Amerimnon Spruceanum (Benth.) Kuntze, Rev. Gen. Pl. 159 (*Dalbergia Spruceana* Benth. in Mart. Fl. Bras. 15: Part 1, 223.) (?) Between Guanai and Tipuani, Apr.–June, 1892 (1408). M. Micheli, who kindly compared this for me with the specimens at Kew, thought that it did not exist there, but I subsequently found it to agree so closely with one of the two specimens (not the one from Santarem) thus marked by Mr. Bentham, that I think it may be thus referred.

Amerimnon—in fruit only and not determinable. Vic. Mapiri, July–Aug., 1892 (1471).

PLATYMISCIUM COCHABAMBENSE sp. n.

Glabrous; brancnes short and stout, light-gray, verrucose; petioles 2.5 or 3 cm. long, stout, the internodes of the rhachis, except the terminal, about as long, both stipules and stipellae wanting; leaflets 7, the petiolules 3 or 4 mm. long, stout; blades 5–8 cm. long, 3–4 cm. broad, the upper larger, oval, occasionally slightly ovate or obovate, the base rounded, the apex abruptly very short and obtusely pointed; entire, very thick, finely and inconspicuously reticulate-veined, the primaries about 7–9 pairs, alternating with shorter ones; racemes solitary in the axils and several at the summit, sessile or unequally peduncled, 8–10 cm. long, simple, rather densely flowered, the flowers mostly solitary, the pedicels about 2 mm. long, bearing a sheathing semicircular thickened gland near the base of the calyx, both bracts and bractlets wanting; calyx obliquely campanulate, 5 mm. long and broad, thick, the teeth short, triangular-ovate, obtuse; corolla 1 cm. long, the petals subequal, the standard slightly the longest; stamens unequal, slightly shorter than, style slightly exceeding, the petals; stipe stout, about as long as the ovary, fruit not seen.

Espirito Santo, 1891 (1181).

SCLEROLOBIUM RADLKOFERI sp. n.

Lightly ferruginous or blackish-tomentose, except the glabrous

and shining upper leaf-surfaces; branchlets and petioles strongly angular; stipules and stipellae not seen; petioles 3 or 4 cm. long, dilated at the base, the internodes about 2 or 2.5 cm. long; leaflets mostly 15, the petiolules 4 or 5 mm. long, dilated, blackish-tomentose, the blades .5 to nearly 1 dm. long, 3.5–6 cm. broad, the upper larger, oval-ovate, the base slightly cordate and very oblique, the apex very short-pointed; entire, revolute, thick, coriaceous, the midrib and 6–8 pairs of primaries impressed above, very stout and prominent beneath; panicles terminal, mostly about 2 dm. long, open, the peduncle and branches very stout and strongly angled, the latter erect; flowers sub-sessile, about 5 mm. long and broad; calyx, and especially the corolla, gray-tomentose, the filaments and ovary densely bright ferruginous-hirsute; fruit not seen, apparently glabrate.

Between Tipuani and Guanai, Dec., 1892 (1690). Dedicated to Prof. Dr. L. Radlkofer, who kindly determined the genus.

Caesalpinia pulcherrima (L.) Swz Obs. 166. Between Guanai and Tipuani, Apr.–June, 1892 (1386).

Cassia trachypus Mart. Fl. Bras. 15: Part 2, 122. Between Guanai and Tipuani, Apr.–June, 1891 (1345) = Rusby's 986.

Cassia hirsuta L. Sp. Pl. 378. Vic. Guanai, July, 1892 (1605).

Cassia bicapsularis L. Sp. Pl. 376. Espirito Santo, 1891 (1188).

Cassia versicolor Meyen in Vog. Syn. Cass. 29. Espirito Santo, 1891 (1171).

Cassia racemosa Mill. Dict. ed. 8, no. 19. Vic. Guanai, July, 1892 (1610).

Cassia bacillaris L. f. Supp. 231. Mapiri, July–Aug., 1892 (1561) = Rusby's 2400.

Cassia—sp. in flower only, not represented at Kew, but fruit is necessary for identification. Below Cochabamba, 1891 (1090).

Bauhinia inermis (Cav.) Pers. Syn. 1: 455 ? Between Guanai and Tipuani, Apr.–June, 1892 (1342). The legume is rather shorter and broader than in the type.

Tamarindus Indica L. Sp. Pl. 34. Between Tipuani and Guanai, Dec. 1892 (1736).

Copaiba Langsdorffii (Desf.) Kuntze, Rev. Gen. Pl. 172 (*Copaifera Langsdorffii* Desf. Mem. Mus. Par. 7: 377. *pl. 14*)? Vic. Mapiri, July–Aug. 1892 (1508). The fruit appears rather too large and the leaflets too broad, inequilateral and falcate for the species, but the specimen is in fruit only.

Piptadenia communis Benth. in Hook. Lond. Jour. Bot. 4: 337. Guanai, Apr.–June, 1892 (1361) = Rusby's 1307.

Mimosa Soratensis Benth. Trans. Linn. Soc. 30: 427. Vic. Sorata, May, 1892 (1317) = Rusby's 1299.

Mimosa rufescens Benth. in Mart. Fl. Bras. 15: 362. Guanai, Apr.–June, 1892 (1505) = Rusby's 1304.

Mimosa albida Kunth, Mim. *pl. 1.* Guanai, Apr.–June, 1892 (1435) = Rusby's 1297.

Acacia Bonariensis Gill. in Hook. Bot. Misc. 3: (1833) 207. Espirito Santo, 1891 (1168).

Acacia riparia H.B.K. Nov. Gen. 4: 276. Between Tipuani and Guanai, Dec., 1892 (1671).

ACACIA MICHELII sp. n.

Much and flexuously branched, the branchlets stout, reddish-brown, striate and finely tuberculate, the internodes 1.5–2 cm. long; spines recurved-spreading, 2–4 cm. long, slender, very pungent, bluntly keeled, the older whitish and minutely black-dotted, the younger light-brown; leaves mostly petioled, 5–6-jugate, 3–5 cm. long, 2–3 cm. broad, the pinnae sub-sessile, 15–20-jugate, the leaflets sessile, 4–5 mm. long, .5–1 mm. broad, oblong, with sub-cordate base and rounded apex, pale, thickish, glabrous, the veins very obscure; peduncles solitary, erect, slender, about 2 cm. long; heads globose. Fruit about 5 or 6 cm. long, 1 cm. broad, blunt, moderately flattened, lightly constricted between the 5 or 6 seeds, brown.

Vic. Cochabamba, 1891 (1095). Near *A. constricta.*

Calliandra Boliviana Britton, Bull. Torr. Bot. Club, 16: 327. Guanai, July, 1892 = Rusby's 1314 and 1315.

CALLIANDRA INAEQUILATERA sp. n.

Branchlets slender, light gray-brown, striate, the younger puberulent, the internodes 3–4 cm. long; stipules indurated, 5 mm. long, ovate, abruptly contracted near the middle and tapering above, obtuse or acutish, strongly many-nerved; common petioles 1–1.5 cm. long, stout, puberulent, bearing a single pair of very short-petioled unequal pinnae; stipellae similar to the stipules; leaflets 4–7 pairs, subsessile, 2–4 cm. long, .7–1.4 cm. broad, the upper larger, lance-ovate, inequilateral and falcate, the base rounded or subcordate, the apex obtuse and cuspidulate; entire, revolute, coriaceous, deep green, above glabrous and shining, underneath pubescent on the veins, 2-nerved, strongly reticulate; peduncles solitary in the axils, scarcely half the length of the leaves; heads 4 or 5 cm. in diameter when in full bloom, scarlet or

crimson; calyx 3–4 mm. long, campanulate, strongly many-nerved, the teeth short, triangular-ovate; corolla infundibular, more than twice the length of the calyx, strongly about 25-nerved, the teeth 2 mm. long, ovate, obtuse; stamens many times the length of the corolla; fruit not seen.

Vic. Guanai, 1892 (1586).

In some respects this appears more like a *Pithecolobium*, but its venation marks it a *Calliandra*, in the section *Macrophyllae*.

Pithecolobium sophorocarpum Benth. in B. & H. Gen. Pl. 1: 598.

Var. (?) ANGUSTIFOLIUM var. nov.

The leaflets are 1.5 cm. long by about 3 mm. broad at the clasping cordate inequilateral base, which is conspicuously yellow-tufted, the margin is ciliate, the lower surface pale and very prominently reticulate, the rhachis hirsute. It appears to me to be a distinct species, but flowers are lacking.

Vic. Guanai, 1892 (1606).

PITHECOLOBIUM VENOSUM sp. n.

A large tree, the foliage softly pubescent except the upper leaf-surfaces; branchlets unarmed, stoutish, angular, flexuous, the internodes short and unequal; stipules not apparent; petioles strongly articulated to a prominently enlarged base, longer than the internodes of the rhachis, stout, angled; pinnae about 6 pairs, imperfectly opposite, their petioles swollen at the base, the lowest 2- the uppermost 4-jugate; glands 1 mm. below the insertion of the leaflets, conspicuous, orange-colored to brown; leaflets regularly enlarging upward, 2.5–5 cm. long, 1.5–4 cm. broad, on petioles about as broad as long, inequilateral, rhomboidally oval, subrotund at base and apex, shortly and bluntly cuspidate, entire, slightly revolute, coriaceous, dark-green and glabrous above, pale beneath, finely and strongly reticulate, the 5–8 pairs of primaries and veins prominent, especially beneath; peduncles solitary in the axils and clustered at the summit, .75 to 1 dm. long, erect or ascending, angled; flowers densely capitate; calyx 1 cm. long, infundibular, the teeth very short, triangular-ovate, yellowish pubescent; corolla about 1.6 cm. long, divided nearly down to the calyx, the lobes oblong, with rounded apices; stamens about thrice the length of the corolla; stigma inconspicuous; legumes (only the very youngest seen) coiled in a circle.

Between Guanai and Tipuani, Apr.–June, 1892 (1392). Related to *P. ferrugineum* and *P. lusorium*.

Inga Bourgoni (Aubl.) DC. Prodr. 2: 434. (*Mimosa Bourgoni* Aubl. Pl. Guian.) Between Guanai and Tipuani, Apr.–June, 1892 (1439).

Inga marginata Willd. Sp. 4: 1015 (excluding the synonymy). Espirito Santo, 1891 (1179). Also collected by Pearce at Coroico.

Inga heterophylla Willd. Sp. 4: 1020. Between Guanai and Tipuani, Apr.–June, 1892 (1421).

INGA PALLIDA sp. n. (Sect. *Euinga*).

Ferruginous-tomentose, the branchlets rather slender, the internodes 4 to 8 cm. long; stipules lanceolate, caducous; petioles two-thirds the length of the internodes, about equalling the internodes of the rhachis, stout, quadrangular; leaves tri-jugate, the petiolules nearly as broad as long, the leaflets 1–2 dm. long, 3–6 cm. broad, the upper successively larger, lance-oblong, inequilateral, with subcuneate base and abruptly acuminate apex, above very pale with minute ferruginous dots, the midrib prominent and ferruginous, the veins impressed, the primaries about 20 pairs, underneath strongly ferruginous, the veins prominent and finely and strongly reticulate; spikes axillary (mostly 3) strongly peduncled, unequal, the longest mostly exceeding the rhachis of the leaf, dense above, slightly interrupted below, about 1.5 cm. thick; bracts linear, nearly as long as the calyx; calyx tubular-campanulate, 3 mm. long, the teeth 1 mm. long, obtusely triangulate; corolla infundibular, 5 mm. long, the lobes 1 mm. long, triangulate; stamens about twice the length of the corolla, united to about the middle; stigma inconspicuous; fruit not seen.

Espirito Santo, 1891 (1165).

ROSACEAE.

Hirtella Americana Aubl. Pl. Guian. 1: 247. Between Guanai and Tipuani, Apr.–June, 1892 (1468)=Rusby's 1311.

Prunus Brittoniana Rusby, Mem. Torr. Bot. Club, 3: (3) 24. Vic. Sorata, Nov., 1892 (1619)=821, also Mandon's 677 and Spruce's 5992.

PRUNUS PEARCEI sp. n. (Sect. Padus).

Branches slender, blackish, the internodes 3 to 4 cm. long; petioles 1.5 cm. long, 2 mm. broad, channelled, reddish-brown; blades 1–2 dm. long, 4–8 cm. broad, oval, the smaller varying to ovate, the larger to obovate, slightly and obliquely pointed, the base rounded and obscurely produced, entire, strongly revolute, coriaceous, both surfaces pale, glabrous, slightly shining, the midrib prominent and deeply but narrowly channelled above, more prominent underneath, the primaries about 5 to 8 pairs, imperfecty opposite toward the base, obscure above, prominent underneath, coarsely anastomosing by the secondaries; racemes solitary

in the axils, shorter than the leaves, weak and slender, rather loosely flowered; pedicels 1 to 1.5 mm. long, very stout, divaricate, articulated and leaving prominent broad scars; calyx puberulent, broadly turbinate, 2 mm. long, shallowly lobed, the lobes broadly semicircular; petals orbicular, 1.5 mm. long; fruit not seen.

Between Guanai and Tipuani, Apr.–June, 1892 (1465). Collected also by Pearce at Chailla, alt. 3,000 ft.

PRUNUS GUANAIENSIS sp. n. (Sect. Padus).

Branches reddish, slender, the internodes about 2 cm. long; petioles 1–1.5 cm. long, stout; blades 1–1.5 dm. long, 3–6 cm. broad, ovate, the base rounded, the apex slightly pointed, entire, sharply revolute, coriaceous, deep green, drying brown, glabrous both sides, shining above, the midrib channelled above, prominent underneath, veins obscure, or the 7–10 pair of primaries, alternating with as many short intermediate ones, slightly prominent underneath, obscurely anastomosing near the margin; racemes solitary in the axils, distinctly but variably peduncled, about half the length of the leaves, very slender and loosely flowered; pedicels 5 mm. long, very slender, pendulous; calyx-tube hemispherical, 1 mm. deep, 2 mm. broad, the teeth triangular; petals orbicular, scarcely 1 mm. long; fruit (dry) globose, broader one way, about 1 cm. in diameter, the surface deep reddish-brown, dull, conspicuously reticulate.

Between Guanai and Tipuani, Apr.–June, 1892 (1432). Very distinct from the last in form and color of leaves and in all the inflorescence characters.

Rubus megalococcus Focke, Abhand. Nat. Gesell. Brem. 4: 157. Vic. Sorata, Nov., 1892 (1618)=Rusby's 470 and 472 and Mandon's 662.

Rubus roseus Poir. Encyc. 6: 265. Vic. Sorata, 8,000 ft., Nov., 1892 (1617, as to those specimens with strongly angled stem, prickly peduncles and rhachis, and few flowers)=Mandon's 659 and 661. This yields a nearly fleshless bony bitter inedible blackberry, and is in herbaria confused with the next. It appears to me identical with *R. Mandoni* Focke.

Rubus Bogotensis H. B. K. Nov. Gen. 4: 158. Vic. Sorata, 8,000 ft., Nov., 1892. The same as Triana's no. 4189 from New Grenada. No. 684, previously enumerated as *R. Bogotensis*, is distinct and is the equivalent of Rusby's no. 474 and Mandon's 657.

Osteomeles pernettyoides (Wedd.) Britton, Bull. Torr. Bot. Club 16: 11. Below Cochabamba, 1891 (1086).

SAXIFRAGEAE.

Hydrangea scandens Poepp. ex DC. Prod. 4: 666. Between Guanai and Tipuani, Apr.–June, 1892 (1437).

ESCALLONIA BRIDGESII sp. n.

Sparingly armed with short stout more or less recurved prickles; branchlets short, very stout, red, very coarsely and bluntly angled; leaves very numerous, scattered and crowded at the ends of the short branchlets, extremely irregular in size, the largest about 1 dm. long, 3 or 4 cm. broad, obovate with narrowed base and rounded apex, very finely serrate, thickish and rigid, glabrous above, puberulent on the principal veins underneath, the primaries 12 to 15 pairs, very irregular and crooked, venation very prominent and coarsely reticulate underneath; panicles terminal and in the upper axils, on peduncles about one-fourth their length, broad and lax, the branches divaricate or slightly recurved, the rhachis and branches strongly angled, puberulent; bracts green, linear-oblong, acute, longer than the pedicels, nearly equalling the flowers; pedicels divaricate, 2–3 mm. long; calyx-tube hemispherical, 2.5 mm. broad, 5-angled or costate; the triangular-ovate, acuminate acute lobes about as long as the tube; petals white, ovate-oval with rounded apex, nearly twice the length of the calyx-lobes; style nearly as long as the calyx-teeth, stout, angled, the stigma peltate, lobed, nearly 1 mm. in diameter; fruit not seen.

By the action of water the leaves are turned to a greenish-indigo color.

Turedon, 1891 (1130). Also collected in Bolivia by Bridges.

ESCALLONIA ADSCENDENS sp. n.

Glabrate; apparently an alpine dwarf, diffusely branched, the branches ascending, blackish, the branchlets red; leaves crowded, 5–7 mm. long, 4–5 mm. broad, obovate, tapering to the sessile or barely petioled base, the apex rounded, occasionally retuse or short-pointed, serrate or crenate-serrate, revolute, thick and rigid, minutely puberulent when young, faintly papillose, the midrib impressed above, very prominent beneath, the venation indistinct; flowers solitary at the ends of the branchlets, the very short red peduncle continuous with the broadly turbinate angled calyx-tube, which is 3 mm. long, nearly 4 mm. broad, and dark colored; calyx-limb yellowish white, 6 mm. broad, lobed more than halfway to the base, the lobes triangular, acuminate and acute, rigid, green; petals 5 or 6 mm. long, obovate, veiny; ovary depressed, the style very stout, angled, 4 mm. long, the stigma peltate, 1 mm. broad; fruit not seen.

Vic. Cochabamba, 1891 (1089). The same as Mandon's no. 603 and also collected by Pearce at Ayacucho, 12,000 to 13,000 ft.

Windmannia fagaroides H.B.K. Nov. Gen. 6: 54. Below Cochabamba, 1891 (1085).

WINDMANNIA SESSILIFOLIA sp. n.

The dark brown branchlets, inflorescence and midrib tomentellate, otherwise glabrous; leaves sessile or some of them barely petioled; 4–6 cm. long, 3–4 cm. broad, the pair at the base of the inflorescence about half as large, ovate, with slightly cordate base and rounded apex, coarsely but regularly crenate-serrate, the teeth strongly incurved, coriaceous and very thick, pale, shining above, very finely and strongly reticulate both sides, brownish underneath, where the midrib is coarsely hairy, the primaries about 12 pairs, ascending at about 45° with the midrib; racemes geminate at the summits, 1.5–2 dm. long, inclusive of the peduncle which is about a fifth of their length; pedicels mostly about 6 together, very slender, 5 or 6 mm. long, the bracts, when present, nearly half their length, thin and weak; calyx 3–3.5 mm. broad, the sepals ovate, acute, thin; styles slender: fruit not seen.

Vic. Sorata, 10,000 ft., 1892 (1577). The same as one collected by Pearce at Huaycani, 9,000 to 11,000 ft.

WINDMANNIA COCHABAMBENSIS sp. n.

Glabrous throughout; branchlets blackish; leaves subsessile, 4–8 cm. long, 3–5 cm. broad, the floral only slightly smaller, ovate with rounded or subcordate base and acute apex, coarsely and acutely serrate, coriaceous but not thick, pale and shining above, deep rusty-brown underneath, inconspicuously and rather coarsely reticulate, the primaries 15–20 pairs, nearly divaricate; racemes solitary in the upper axils and a terminal pair, 6–8 cm. long, including the peduncle, which is about half that length; pedicels mostly 3 together, 3 mm. long, stout, the bracts more than half their length, ovate, thick and rigid; calyx 4–5 mm. broad, the sepals ovate, tapering and acute, thick and rigid; styles stout. Seen only in young fruit.

Espirito Santo, 1891 (1198). Very near No. 1577, but the venation and toothing of the leaves and the inflorescence mark it clearly distinct. The same as Matthews' no. 1203 from Peru.

CRASSULACEAE.

Tillaea connata R. & P. Fl. Per. 1: 70. Turedon, 1891 (1138).

HALORAGEAE.

GUNNERA BOLIVIANA Morong, sp. n.

Stem compressed, sulcate, nearly 2 cm. broad below, glabrous or with a few minute scales; flowers polygamous, in long subver-

ticillate or scattered spikes, mostly staminate or perfect above and pistillate below; spikes numerous, linear, 4–20 cm. long, the rhachis striate and glabrous, or slightly pubescent; calyx-lobes 2, minute, ovate, denticulate at the apex; petals on the staminate and perfect flowers 2, alternate with the lobes of the calyx, obovate, with a short claw, denticulate or minutely fringed at the apex, 1–2 mm. long, greenish white, caducous; stamens 2, filaments filiform, longer than the anthers; anthers oval, 1 mm. long, 2-celled, dehiscing by lateral slits; pistillate flowers 1 mm. long, apetalous, styles 2, much exserted, papillose, wholly stigmatic; leaves obovate in outline, deep green and glabrous on both surfaces, except in having a few scattered teeth and a slight pubescence on the nerves, deeply several-lobed, the lobes ovate, acute, incisely lobed and with many small cartilaginous teeth on the margins; the leaves on the specimens imperfect, but they appear to be 2- or 3-palmately nerved from the base, the nerves branching above and running into the apices of the lobes, the leaf tapering abruptly into a petiole.

Espirito Santo, 1891 (1214) = Mandon's 598 in Herb. Kew. *Myriophyllum Titicacense* Remy, Analact. Boliv. Near snow-line, Mt. Tunari, 1891 (1031).

COMBRETACEAE.

COMBRETUM GUANAIENSE sp. n.

Branchlets rather slender, the internodes .8–1 dm. long; petioles about 1 cm. long, blades 1 to nearly 2 dm. long, 4–10 cm. broad, ovate to oval, the base subcordate, the apex abruptly contracted into a slender acute point, coriaceous and very thick, above dark green, glabrous and shining, underneath ferruginous-tomentose and sparingly red-lepidote, midrib and 6–8 pairs of primaries prominent both sides, the latter strongly connected by the secondaries; spikes (always?) solitary in the axils, shortly and stoutly peduncled, 1.5 dm. long, densely red-lepidote; calyx-tube 3–4 mm. long, 1 mm. broad, strongly 4-angled, the limb about 7 mm. long, its cylindrical portion 1 mm. long, the open campanulate portion divided one-third of the way down, the lobes broadly triangular, acute, separated by rounded sinuses; petals yellow, obovate with rounded apex, nearly as long as the calyx-lobes; stamens 8, the longest 2 cm. long; fruit not seen.

Vic. Guanai, Apr.–June, 1892 (1320). The same as Rusby's number 623, collected at the same place in 1886. Near *C. Aubletii* DC., but tomentose, and with a different calyx.

COMBRETUM NUMMULARIUM sp. n.

Branchlets slender, terete, dark brown; petioles 5–8 mm. long, blades .75–1 dm. long, 3–6 cm. broad, oval with rounded

base and abrupt short blunt point, deep green and minutely lepidote both sides, the scales dull, gray-green; peduncles and branches of the inflorescence elongated (in fruit), subfiliform; flowers not seen; fruit, as pressed, orbicular or a little broader than long, about 5 cm. across, glabrous.

Between Guanai and Tipuani, Apr.–June, 1892 (1378).

COMBRETUM GLORIOSUM sp. n.

Branchlets stout, light brown, the internodes about 6 cm. long; petioles 1–2 cm. long, blades 1–1.5 dm. long, 6–10 cm. broad, oval-elliptical or the base very slightly produced, entire, not revolute, membranaceous but rigid, above obscurely, underneath conspicuously, golden-lepidote, finely veined, the primaries about 7 pairs, strongly ascending-curved, lightly connected by the secondaries; panicles sessile, of few spikes, the branches very stout, the densely golden-lepidote spikes secund, 1 dm. long, shortly peduncled, densely flowered; calyx-tube nearly 3 mm. long, 1 mm. broad, sharply 4-angled, sharply articulated with the limb, which is 6–7 mm. long, the lower half cylindrical and narrower than the tube, the upper open-campanulate and lobed nearly half its length, the lobes triangular-ovate; petals yellow, oval, two-thirds the length of the calyx-lobes; stamens 8, golden-yellow, the longest 1.5 cm. long, the anthers purple; fruit not seen.

Between Guanai and Tipuani, Apr.–June, 1892 (1427). Near *C. Lindbergii* Eichl.

Combretum—sp. Probably undescribed, and near *C parviflorum*, but in the absence of flowers a determination is not possible. Between Guanai and Tipuani, Apr.–June, 1892 (1334) = Rusby's 2635, also without flowers.

SPARATTANTHELIUM GLABRUM sp. n.

A climbing shrub, glabrous except for the minute scales, the branches ramose, flexuous, brown, costate; petioles about 2 cm. long, slender, blades 7–11 cm. long, ovate with rounded base and abrupt obtusish point, entire, minutely lepidote, coriaceous, strongly 3-nerved from the petiole, the venation inconspicuous; flowers not seen; fruiting cyme compound, very broad and open, the branches, pedicels and fruit strictly erect; fruit a little more than 2 cm. long, about 1 cm. broad, ovoid, the apex blunt, tipped with the reddish styles which are about 1 mm. long, strongly but bluntly 6–8-costate, cinereous.

Between Guanai and Tipuani, Apr.–June, 1892 (1371).

MYRTACEAE.

Psidium pomiferum L. Sp. Pl. ed. 2, 672. Between Tipuani and Guanai, Dec., 1892 (1688) = 253.

Myrtus microphylla Humb. et Bonp. Pl. Equin. *pl. 4.* Vic. Mapiri, 12,000 ft., 1892 (1573) = Rusby's 2042.

MYRCIA BANGII sp. n.

Ferruginous-tomentose upon the branchlets, inflorescence and venation; branchlets strict, the internodes 5–7 cm. long; petioles 1 cm. long, stout; blades 1–2 dm. long, 4–8 cm. broad, ovate with acute base and abrupt short blunt point, entire, coriaceous, deep green, glabrous above, prominently reticulate underneath, the primaries about 15 to 20 pairs, nearly divaricate, lightly curved, anastomosing close to the margin; inflorescence sessile, trichotomous, open, the flowers densely clustered at the ends of the branchlets, sessile; bud globose, 3 mm. in diameter; calyx-tube broadly campanulate, about 1 mm. long and broad, the lobes about as long, triangular-ovate; petals 3 mm. long; stamens numerous and dense; fruit not seen.

Between Tipuani and Guanai, Dec., 1892 (1644). Near *M. Selloana.*

Myrcia Paivae Berg, in Mart. Fl. Bras. 14: Part 1, 179. Between Tipuani and Guanai, Dec., 1892 (1700).

Myrcia cucullata Berg, Linnaea, 27: (1854) 97. Between Tipuani and Guanai, Dec., 1892 (1709).

MYRTUS OSTEOMELOIDES.

Apparently alpine and dwarf, diffusely branched, the branchelets crowded, but a few centimeters long, very leafy, the internodes 1–3 mm. long; petioles 1–2 mm. long, very broad; blades 1–1.5 cm. long, 4–8 mm. broad, obovate with narrowed base and rounded retuse apex, very thick, dark green and shining above, yellowish and papillose underneath, entire, strongly revolute, midrib stout and prominent underneath, venation inconspicuous; panicles terminal, short and broad, the branches short and stout; pedicels 3–5 mm. long, stout; bracts manifest, but caducous, narrow; calyx-tube narrowly turbinate, 1.5 mm. long and two-thirds as broad, the limb (yellowish-white), nearly 3 mm. broad, divided midway, the lobes thick and rigid, triangular-ovate, obtuse; petals 3 mm. long, obovate, thickish, drying yellowish; cells about 8-ovuled.

Vic. Sorata, Nov., 1892 (1623). The same as Mandon's 636, and also one by Moritz (no. 1184) probably from Venezuela.

EUGENIA UNINERVIA sp. n. (Sub. Eueugenia.)

Glabrous, except the scurfy petioles, much branched and very leafy; the internodes mostly 1–1.5 cm. long; petioles 2–4 mm. long, rather stout; blades 4–6 cm. long, 1–1.5 cm. broad, ob-

long, regularly and equally tapering to both ends, acutish, entire, revolute, coriaceous, the midrib above not prominent, of a brighter green than the leaf-surface, underneath prominent, the venation inconspicuous, coarsely reticulate; pedicels geminate, from an excessively short node-like branch, scarcely bracted, 6–8 mm. long, slender, ascending; calyx-tube turbinate, 2 mm. long and broad, dark-colored, the lobes (4) bright green, about the same length, triangular-ovate, acute; petals nearly twice the length of the calyx-lobes; fruit not seen.

Vic. Guanai, July, 1892 (1602). Near *E. glaucescens* Camb.

LECYTHIS ANDINUS sp. n.

Petioles 2–3 cm. long, excessively stout; blades 2–4 dm. long, 7–14 cm. broad, oblong-lanceolate with slightly produced base and very short abrupt blunt point, coriaceous but not thick, glabrous, dark green above, pale underneath, midrib sharply prominent above, underneath very stout and several-ribbed, the primaries about 25 pairs, anastomosing less than 1 cm. from the margin; panicle diffusely branched, the branches stout, much and sharply wrinkled, light brown; pedicels very short, as broad as long; calyx-tube (in flower) 5 or 6 mm. long, turbinate, the limb 1 cm. broad, divided midway, the lobes broadly ovate, rounded; petals (color?) coriaceous, obovate, 2.5–3 cm. long; fruit not seen.

Mapiri, July—Aug., 1892 (1522). Very near Jenman's 4155, from British Guiana.

MELASTOMACEAE.

(Communicated by Dr. A. Cogniaux.)

Arthrostemma campanulare (Naud.) Tr. Melast. 35 (*Heteronoma campanulare* Naud. Ann. Sci. Nat. (III.) 16: (1851) 153. Espirito Santo, 1891 (1221).

Tibouchina Rusbyi Cogn. Bull. Torr. Bot. Club, 17: 54. Espirito Santo, 1891 (1246) = Rusby's 2339.

Tibouchina granulosa angustifolia Britton, Bull. Torr. Bot. Club, 17: 54. Espirito Santo, 1891 (1166) = Rusby's 2245.

Adelobotrys ascendens (Swz.) Tr. Melast. 67. (*Melastoma ascendens* Swz. Fl. Ind. Occ. 2: 772). Between Tipuani and Guanai, Dec. 1892 (1702).

Miconia calvescens DC. Prod. 3: 185. Vic. Cochabamba, 1891 (1160) = Rusby's 2264.

Miconia dodecandra (Desr.) Cogn. in Mart. Fl. Bras. 14: 4 (*Melastoma dodecandra* Desr. Lam. Encyc. 4: 46). Mapiri, July–Aug., 1892 (1487).

MICONIA ERIONEURA Cogn. sp. nov. (sect. Octomeris); ramis apice alternatim hinc et inde valde compressis; foliis magnis, rigidiusculis, elongato-oblongis, breviter obtuseque acuminatis, basi rotundatis, margine integerrimis et densiuscule breviterque ciliatis, 5-plinerviis fere 5-nerviis supra glabris laevibusque, subtus ad nervos breviuscule denseque villoso-hirtellis caeteris brevissime sparseque pilosulis; floribus 5-meris, subsessilibus; calyce glabro, obscure verruculoso, limbo truncato.

Rami robusti, juniores ad nodos brevissime denseque annulato-pilosi caeteris glabrati. Petiolus robustus, densiuscule breviterque pilosus, 3–6 cm. longus. Folia intense viridia, 2–3 dm. longa, 5–8 cm. lata; nervis robustis, supra latis impressis, subtus valde prominentibus; nervulis numerosis, subrectis, subtus satis prominentibus. Paniculae angustae, submultiflorae, 1½ dm. longae, ramis simplicibus vel paullo ramulosis. Calyx basi rotundatus, 6 mm. longus, limbo satis dilatato, 7 mm. lato. Petala glabra, rigida, subquadrangularia, apice oblique subtruncata, 5–6 mm. longa. Antherae anguste oblongae, 4–5 mm. longae. Stylus robustus, apice truncatus et vix dilatatus, 8–9 mm. longus. Species *M. Schlimii* Triana (Cogn. l. c. 757) proxima.

Between Tipuani and Guanai, Dec., 1892 (1683).

Miconia glandulifera Cogn. Melast. 737. Var. BOLIVIENSIS Cogn. n. var.

Folia integerrima vel vix undulata, fere 5-prinervia. Calyx dense furfurascens.

Vic. Cochabamba, 1891 (1173).

Miconia holosericea bracteata Cogn. Melast. 237. Between Tipuani and Guanai, Dec., 1892 (1647) = Rusby's 2250 and 2297.

Miconia Ibaguensis (Bonp.) Tr. Melast. 110. Mapiri, July–Aug., 1892 (1525) = Rusby's 2262, 2277 and 2289.

Miconia Matthaei Naud. Ann. Sci. Nat. (III.) 16: 176. Mapiri, July–Aug., 1892 (1492).

Miconia minutiflora (Bonp.) DC. Prod. 3: 189. (*Melastoma m.* Bonp. Melast. 150. *pl. 22.*) Between Guanai and Tipuani, Apr.–June, 1892 (1402) = Rusby's 2276 and 2294.

Miconia persicariaefolia Cogn. Bull. Torr. Bot. Club, 17: 59. Between Guanai and Tipuani, Apr.–June, 1892 (1410) = Rusby's 992.

Miconia prasina (Swz.) DC. Prod. 3: 188. (*Melastoma p.* Swz. Prod. 69.) Between Tipuani and Guanai, Dec., 1892 (1698) = Rusby's 2257 and 2267.

Miconia punctata (Desr.) D. Don. Mem. Wern. Soc. 4: 316. (*Melastoma p.* Desr. Lam. Encyc. 4: 50.) Between Tipuani and Guanai, Dec., 1892 (1685).

Miconia theaezans subtriplinervia Cogn. Melast. 421. Mapiri, July–Aug., 1892 (1537).

Miconia tiliaefolia Naud. Ann. Sci. Nat. (III.) 16: 151. Between Guanai and Tipuani, Apr.–June, 1892 (1453) = Rusby's 2322.

Miconia undata Tr. Melast. 107. Var. BOLIVIENSIS Cogn. var. nov. Petiolus 1–2½ cm. longus; folia breviore acuminata, nervis supra paulo impressis.

Mapiri, July–Aug., 1892 (1502).

Clidemia capitellata (Bonp.) D. Don, Mem. Wern. Soc. 4: 310. (*Melastoma c.* Bonp. Melast. 5. *pl. 3.*) Between Tipuani and Guanai, Dec., 1892 (1706).

Clidemia hirta (L.) D. Don, Mem. Wern. Soc. 4: 309, excl. syn. (*Melastoma hirta* L. Sp. Pl. 390). Between Tipuani and Guanai, Dec. 1892 (1705); Espirito Santo, 1891 (1193) = Rusby's 2236, 2239 and 2240.

Bellucia imperialis Sald. et Cogn. in Mart. Fl. Bras. 14: Part 4, 515. Between Tipuani and Guanai, Dec., 1892 (1645) = Rusby's 2330.

Mouriria parviflora Benth. Bot. Sulph. Voy. 97. *pl. 36.* Espirito Santo, 1891 (1206) = Rusby's 2681.

LYTHRARIEAE.

(Communicated by Dr. E. Koehne.)

Adenaria floribunda H. B. K. Nov. Gen. 6: 188. Vic. Sorata, May, 1892 (1311) = 374, and Rusby's 1419.

Cuphea ianthina Koehne, in Mart. Fl. Bras. 13: Part 2, 238. Below Cochabamba, 1891 (1066).

Cuphea ianthina forma (?). Espirito Santo, 1891 (1245). [This species I had determined as *C. cordata* R. & P. Syst. Veg. 119, when Dr. Koehne favored me with his determination as above. The species of this section Dr. Koehne regards as very puzzling. H. H. R.]

Cuphea setosa Koehne, Mart. Fl. Bras. 13: Part 2, 223. Espirito Santo 1891 (1227 and 1238) = Triana's specimen collected at 1000 metres altitude near Bogota, and Lechler's 2322 from Peru.

Cuphea Spruceana Koehne, Mart. Fl. Bras. 13: Part 2, 226. Var. BANGII Koehne, var. nov. Differt a typo foliis obtusiusculus et calyce parce breviterque hispidulis. Espirito Santo, 1891 (1228).

CUPHEA TRICHOPETALA Koehne et Rusby sp. n.

Herba perennis videtur, caulibus paucis 10–17 cm. altis, subascendente-erectis, pubescentibus et glutinoso-hirtellis. Folia internodia circ. aequantia vel paullo longiora, petiolis circiter 1–2 mm. longis, ut caulo vestitis incidentia, e basi obtusiuscule oblonga (10–20 mm.: 4–9 mm.), acuta, rigidula, hirtello-strigosa et superiore pagina saepe parce hispidula, *floralia minora in quave pari subaequalia.* Inflorescentia e racemis brevibus secundis subtrifloris composita circ. 2.5–8 cm. longa. Pedicelli 1–2 mm. longi interpetiolares, apice prophylla 2 minuta ovata instructi. Calyx (8–10 mm.) brevissime calcaratus, pallide violaceo-coloratus nerva intensius violaceis breviter hirtello-pubescentibus et glutinoso-hirtella, dorso subconvexus pauce subampliatus, post anthesis infra medium oblique incrassatus, intus infra stamina in nervis parce villosiusculus, nervis staminum 2 brevium exceptin villosissimis, supra stamina ventre barbatus; lobos dorsalis cateris paullo major et subproductus; appendices brevissimae crassiusculae setulosae. *Petala* 6 violacea calycis ½ longitudinae aequantia, *persistentia*, 2 dorsalia anguste cuneato-obovata, 4 ventralia subbreviora et triente angustiore, *omnia in nervo medio supra parce, subtus dense villosiuscula.* Stamina 11; 9 ventralia ad tubi ⅔ lineae deorsum subconnexae inserta, 5 episepala lobos fere, 4 ventralia sinus vix aequantia, 2 dorsalia parva inferius inserta ceterorum insertionem paullo superantia. Ovarium oblique ovatum glabrum in stylum aequilongum villosissimum subulatum, semper inclusum abiens. Discus horizontalis, crassus, semiorbicularis. Ovula 5–6. Semina 3 mm. longa et lata, castanea, margine vix pallidiora testa ibidem haud incrassata, laevia.

Vic. Cochabamba, 1891 (1008).

Adn. Species propter petala in calyce fructifero persistentia corrugato-inflexa ad sectionem *Pseudocircaeam* Koehne juxta *Cupheam persistentem* Koehne rei publicae Argentinae incolam pertinens, sed petalis pilosis non solum inter Cupheas sed inter Lythraceas omnes distinctissima.

Physocalymna scaberrimum Pohl, Flora (1827) 153. Mapiri, July–Aug., 1892 (1527) = Rusby's 2444.

ONAGRARIEAE.

Jussiaea octonervia Lam. Encycl. 3: 332. Mapiri, July–Aug., 1892 (1494) = Rusby's 1798.

Oenothera rosea Ait. Hort. Kew. 2: 3. Vic. Mapiri, 8,000 ft., Jan., 1893 (1746).

SAMYDACEAE.

Casearia sylvestris Swz. Fl. Ind. Occ. 2: 752. Var. TOMENTELLA var. nov.

The permanence of its indumentum sufficiently distinguishes it from the type, which is early glabrate. It is probably distinct, but until this composite species is analyzed, this form may as well rest within it.

Vic. Guanai, July, 1892 (1592). Collected also by Pearce at Pampas. Matthews' 1601 from Tarapota, Peru, is similar in other respects than the pubescence.

CASEARIA ATTENUATA sp. n. (Sect. Zuelania.)

Glabrous, except the minutely puberulent pedicels and calyx; branchlets slender, somewhat flexuous, striate, reddish brown, the internodes 1.5–3 cm. long; petioles 5 mm. long, broad; blades 8–13 cm. long, 2–3 cm. broad, lance-oblong, the base tapering into the petiole, the apex contracted into a long attenuate tip, obscurely serrate, coriaceous, conspicuously punctate, dark green, reticulate, the venation slightly prominent beneath, the primaries about 5 pairs, strongly ascending; pedicels slender, about 5 mm. long, articulated at about the middle; calyx crateriform, 3.5–4 mm. broad, pistil 2 mm. long, the ovary broadly pyramidal-ovoid, a little longer than the style, the stigma 0.5 mm. broad, peltate, deeply lobed.

Mapiri, July–Aug., 1892 (1529). The same as Burchell's 8439.

Banara pyramidata Rusby, Mem. Torr. Bot. Club; 3: Part 3, 33.

Between Tipuani and Guanai, Dec., 1892 (1692)=365.

Abatia Boliviana (Mand. et Wedd.) Britt. Bull. Torr. Bot. Club, 17: 214. Vic. Sorata, 10,000 ft., Nov., 1892 (1613)=Mandon's 1511 and Rusby's 2468.

LOASEAE.

Klaprothia mentzelioides H. B. K. Nov. Gen. 6: 123. *pl.* 537. Espirito Santo, 1891 (1244).

(For other numbers occurring here, see Part 1.)

TURNERACEAE.

Turnera Weddelliana Urb. et Rolfe, Jahrb. Kgl. Bot. Gart. 2: 90.

Between Guanai and Tipuani, Apr.–June, 1892 (1335)= Rusby's 2653 and 2094.

PASSIFLOREAE.

Passiflora coccinea Aubl.; Mast. Gard. Chron. (1873) 605. Mapiri, July–Aug., 1892 (1557)=Rusby's 492.

PASSIFLORA VENOSA sp. n. (Sect. Astrophea).

Glabrous, erect, non-cirrhose, the branchlets elongated, slender, flexuous, striate, green, the internodes 2 or 3 cm. long; petioles 1–1.5 cm. long, blades 7–12 cm. long, 5–7 cm. broad, ovate, with rounded base and acutely short-pointed apex, coriaceous, bright green, conspicuously reticulate-veined, the 5 pairs of primaries prominent both sides, the others so underneath; pedicels mostly geminate, 1–1.5 cm. long, articulated at the junction of the lowest third, the upper portion dark; calyx-tube less than 5 mm. long, one-half broader, the lobes 1.5–2 cm. long, oblong-oblanceolate, obtuse; petals a little longer (apparently violet or light-purple), linear-oblanceolate, obtuse; crown single, of two series, the divisions of the outer a little more than half the length of the petals, darker, linear-oblanceolate and falcate, the upper margin oblique and obscurely sinuately-lobed, those of the inner scarcely a third as long, filiform or narrowly linear; column 1 cm. long to the base of the style-branches; stamens 5, the filaments and anthers each about 5 mm. long, the former inserted a little above the middle of the column; style-branches 3, nearly as long as the column, the stigma large; fruit not seen.

Between Tipuani and Guanai, Dec., 1892 (1656). Near *P. Mandoni.*

PASSIFLORA URNAEFOLIA sp. n. (Sect. Disemma?)

Glabrous, climbing, stems slender, green, very strongly angled, the internodes 5 or 6 cm. long; petioles 2–3 cm. long; blades (length of midrib) 5–6 cm. long, 6–8 cm. broad, urn-shaped by the abbreviation of the terminal lobe, which is exceeded 1 cm. or more by the two lateral, the outline below the acute apices of the latter regularly rounded, thinly revolute; membranaceous, strongly reticulate, bright green, 3-ribbed; tendrils simple, slender; pedicels geminate in the axils, 2 or 3 cm. long, slender; bracts none; sepals (light-blue?) 2 cm. long, oblong, obtuse; petals about half as long; crown double, the outer of two series; divisions of the outer series linear, 8 mm. long, those of the inner rudimentary, filiform; inner crown a fimbriate thick annulus; stamens 5, inserted at the base of the obovoid ovary, the filaments 1 cm. long, thick and fleshy, white, the anthers 3 or 4 mm. long; styles 3, very slender, green, about 8 mm. long, the stigmas large; fruit on a stipe half its own length, globose.

Mapiri, July–Aug., 1892 (1517). Near *P. Andersonii* DC.; also near *P. capsularis* Lam.

Tacsonia insignis Mast. Gard. Chron. (1873) 1112. *fig. 239.* Mapiri, July–Aug., 1892 (1556)=Rusby's 2465.

Carica Papaya L. Sp. Pl. 1036. Espirito Santo, 1891 (1170) Mapiri, July–Aug., 1892 (1559).

CUCURBITACEAE.

LAGENARIA LEUCANTHA (Duch.) (*Cucurbita leucantha* Duch. in Lam. Encyc. 2: 150. 1786 = *Lagenaria vulgaris*, Ser. Mem. Soc. Gen. 3: (1) 25. *f. 2* (1825)). Between Guanai and Tipuani, Apr.–June, 1892 (1400). The "Maté Gourd."

Momordica Charantia L. Sp. Pl. 1009. Between Guanai and Tipuani, Apr.–June, 1892 (1360). Introduced.

Citrullus vulgaris Schrad. Linnaea, 12: 412. Between Guanai and Tipuani, Apr.–June, 1892 (1399). Escaped.

Cyclanthera pedata edulis (Naud.) Cogn. Cucurb. 826 (*Cyclanthera e.* Naud. Belg. Hort. (1872) 360. Espirito Santo, 1891 (1260). Escaped; the "Acchocte" = Rusby's 491.

BEGONIACEAE.

Begonia scandens Swz. Prod. Fl. Ind. Occ. 86. Mapiri, July–Aug., 1892 (1509) = Rusby's 678.

Begonia Clarkei Hook. f. Bot. Mag. *pl. 5663* and *5675*. Near snow-line, Mt. Tunari, 1891 (1016) = Rusby's 680.

UMBELLIFERAE.

Hydrocotyle ranunculoides L. f. Supp. 177. Near snow-line, Mt. Tunari, 1891 (1020). Without flower or fruit.

Azorella biloba Wedd. Chlor. And. 2: 195. Near snow-line, Mt. Tunari, 1891 (1017) = Rusby's 1952.

Azorella multifida Pers. Syn. 1: 303. Near snow-line, Mt. Tunari, 1891 (1047).

Eryngium nudicaule Lam. Encyc. 4: 759. Near snow-line, Mt. Tunari, 1891 (1028) = Mandon's 585.

Sanicula Mexicana DC. Prod. 4: 84. Espirito Santo, 1891 (1293).

Oreomyrrhis andicola (H. B. K.) Endl. Gen. Pl. 787 (1833). (*Myrrhis andicola* H. B. K. Nov. Gen. 5: 13. *pl. 419.* [1821]) Vic. Sorata, Nov. 1892 (1615) = Mandon's 1769 and 1770.

ARALIACEAE.

Didymopanax Morototoni (Aubl.) Decne et Planch. Rev. Hort. (1854) 109 = (*Panax M.* Aublet. Pl. Gui. 2: 949. *pl. 360* = *Sciadophyllum paniculatum* Britton, Bull. Torr. Bot. Club, 17: 37). Between Guanai and Tipunai, Apr.–June, 1892 (1438) = Seeman's 1615, Jenman's 5928 from Demerara, and Rusby's 608.

CAPRIFOLIACEAE.

Viburnum glabratum H. B. K. Nov. Gen. 3: 428. A little below Cochabamba, 1891 (1087) = Rusby's 2469 and 2584.

RUBIACEAE.

Cinchona ovata R. & P. Fl. Per. 2: 52. *pl. 195.* Between Guanai and Tipuani Apr.–June, 1892 (1404) = Rusby's "E," etc.

Cinchona Josephiana Wedd. Ann. Sci. Nat. (V.) 12: (1869) 58. Vic. Sorata. Nov., 1892 (1612) = Rusby's "F. 4," etc., distributed as *C. amygdalifolia* Wedd.

Cascarilla magnifolia (R. & P.) Wedd. Ann. Sci. Nat. (III.) 10: 10 (*Cinchona m.* R. & P. Flor. Per. 2: 53. Between Guanai and Tipuani, Dec., 1892 (1661).

MACROCNEMUM SPRUCEI sp. n.

A small tree; glabrous except upon the leaf-veins underneath; branchlets short, stoutish, gray, the leaves crowded at the ends; stipules 3 cm. long, 1.5 cm. broad, oval with narrowed base and rounded apex; petioles 2 or 3 cm. long; blades 1–1.5 dm. long, 6 or 7 cm. broad or becoming after the flowering stage nearly twice as large, obovate with cuneate base and slightly produced obtusish apex, veins obscurely pubescent underneath; panicles axillary, 2–3 dm. long inclusive of the peduncles, which comprise nearly half the length, broad, lax, the subulate acute divergent bracts 2–4 mm. long, the pedicels almost absent; calyx-tube 6 or 7 mm. long, infundibular-cylindraceous, the limb 1 mm. long, 3 mm. broad, the teeth triangular, acute, very short; corolla rose-purple, the tube 1 cm. long, cylindrical, the upper third contracted, the limb in the bud hemispherical-ovoid with angled base and rounded summit, the lobes 4 mm. long and broad, rotund-ovate, acute, pilose within; stamens inserted about the middle of the tube, the filaments stout, flattened, bearded, very unequal, the longest reaching to the base of the lobes, the anthers small; style reaching to the base of the corolla-lobes, stout, the stigma small; disc fleshy, annular, prominent; fruit oblong, flattened.

Between Tipuani and Guanai, Dec., 1892 (1635).

The same collected by Spruce. Mr. Bang states that the bark is used for binding thatch and for other purposes requiring great strength and durability, but I think he must refer to some other tree.

Lecanosperma lycioides Rusby, Bull. Torr. Bot. Club, 20 : 431. Vic. Cochabamba, 1891 (1121 and 1122).

Lygistum ignitum (Vell.) Kuntze, Rev. Gen. Pl. 287. (*Guangnebina i.* Vell. Fl. Flum. 1 : *pl. 115*) = *Manettia ignita* Schum. Mart. Fl. Bras. 6 : Part 6, 171. Between Guanai and Tipuani, Apr.–June, 1892 (1372) = Rusby's 1126.

LYGISTUM MICANS (Poepp. & Endl.) (*Manettia m.* Poepp. et Endl. Nov. Gen. et. Sp. 3 : 24 = *M. ignita micans* Schum. in Mart. Fl. Bras. 6 : Part 6, 171). Espirito Santo, 1891 (1255).

LYGISTUM TENUE Britton, sp. n.

Stems elongated, very slender, green, sharply angled toward the summit, and, like the inflorescence, minutely scabrous; stipules short and inconspicuous; petioles 3–5 mm. long, blades 4–7 cm. long, 2–3 cm. broad, ovate with rounded base and acuminate obtuse apex, entire, bright green, glabrous above, minutely scabrous on the midrib underneath, thin, venation very slender and inconspicuous, primaries about 7 on each side; racemes solitary in the axils, compound, secund, few and loosely flowered, about 4 cm. long, the bracts 2 mm. long, oblong, acute, green, the bractlets linear; pedicels 2–3 mm. long, slender; calyx-tube from elongated-hemispherical to truncate-ovoid, 2.5 mm. long, the triangular acute teeth half as long, recurved-spreading; only undeveloped corollas seen, apparently narrowly infundibular, about 1 cm. long; fruit brown, globose, about 4 mm. in diameter.

Vic. Sorata, Nov., 1892 (1725). The same as Rusby's no. 2158, collected near Mapiri. Description taken from Mr. Bang's specimens.

Lygistum —— sp. near *L. umbellatum* and apparently undescribed; but material insufficient. Espirito Santo, 1891 (1268).

Lygistum —— specimens too incomplete. Espirito Santo, 1891 1269.

CONDAMINEA ANGUSTIFOLIA sp. n.

Finely puberulent, except the glabrous upper leaf-surfaces, stipules and corolla; branchlets stout, terete; stipules 3–5 cm. long, 7 mm. broad, lanceolate, long-attenuate, entire, rigid, brownish-green, finely nerved, the midrib very prominent on the upper side, like a keel; petioles less than 1 cm. long and very stout; blades 2.5–3.5 dm. long, 6–8 cm. broad, oblong with subcor-

date base and abruptly short-pointed apex, entire, coriaceous and very thick, above pale green, glabrous and slightly shining and the veins inconspicuous, underneath softly puberulent with the midrib and 18 to 20 pairs of primaries very prominent; cymes very stoutly peduncled, successively trichotomous, the branches widely spreading and elongated; pedicels proper only 5–8 mm. long, very stout, continuous with the calyx-tube which (in flower) is 1 cm. long, infundibular, strongly 4-angled, the limb hemispherical or cup-shaped, 6–8 mm. broad, coriaceous, reddish, the margin sinuately lobed; corolla thick, purple, in bud ovoid with rounded short apiculate apex, the tube campanulate, about 1 cm. long, the lobes ovate, acute, 7 mm. long, 5 mm. broad; filaments inserted a little below the middle of the corolla, nearly 2 mm. broad at the base, the anthers oblong, 8 mm. long, 2 mm. broad, lightly exserted; style about equalling the filaments, very stout; fruit oblong, truncate.

Between Guanai and Tipuani, Apr.–June, 1892 (1429).

Chrysoxylon tubulosum (A. Rich.) Kuntze, Rev. Gen. Pl. 278 (*Macrocnemum tubulosum* A. Rich. in DC. Prod. 4: 403 = *Pogonopus tubulosus* Schum. in Mart. Fl. Bras. 6: Part 6, 265). Between Guanai and Tipuani, Apr.–June, 1892 (1344) Dec. 1892 1716) = Rusby's 2090.

Sipanea pratensis Aubl. Pl. Guian. 1: 147. Mapiri, July–Aug., 1892 (1488) = Rusby's 2461.

ISERTIA RETICULATA Britton, sp. n.

Arborescent; densely and rather harshly short-tomentose throughout; branchlets very stout, obtusely quadrangular; stipules 1.5 cm. long, ovate, acuminate and very acute, entire, obtusely keeled; petioles 2.5–4 cm. long, very stout, semi-cylindrical to nearly cylindrical, the upper surface nearly plane; blades 2–4 dm. long, 1 to nearly 2 dm. broad, obovate, the base acute to cuneate, apex acutely very short-pointed; entire, revolute, thick and rigid, very finely bullate, above dark green, underneath white, the 20 to 25 or 30 pairs of primaries impressed above, very prominent beneath, nearly divaricate, intercommunicating almost at the margin; peduncle and rhachis exceedingly stout, 2 or 3 dm. long, the bracts and bractlets similar to the stipules and smaller; calyx turbinate, about 8 mm. long, the teeth very short; corolla thick and rigid, 4 cm. long, the tube infundibular, the mouth 1.5 cm. broad, the rounded lobes about 7 mm. long, darker than the tube; anthers 7 mm. long, reaching to the middle of the corolla-lobes; style slightly exceeding the stamens.

Between Guanai and Tipuani, Apr.–June, 1892 (1358)=Rusby's 1895.

SABICEA CUNEATA sp. n.

Gray-tomentose throughout except the strigose upper leaf-surfaces; branchlets elongated, stout, striate, purplish, the internodes 4–6 cm. long; stipules 7 or 8 mm. long, 5 mm. broad, ovate, blunt, entire, herbaceous, strongly reflexed; petioles .75–1.5 cm. long, margined; blades .75–1.5 dm. long, 3–4.5 cm. broad, oval-ovate, acuminate and acute at each end, entire, above dark green and strigose, underneath softly gray-tomentose; cymes axillary, trichotomous, on short very stout peduncles, mostly 15–20-flowered, about 2 cm. broad; bracts about 5 mm. long, linear and tapering, herbaceous, recurved, the pedicels 3–5 mm. long; calyx-tube (in flower) 2 mm. long, globose-urceolate, the lobes 5 mm. long, linear-tapering, herbaceous, recurved; corolla purple, pilose, 1 cm. long, the tube infundibular-cylindraceous, the lobes 4 mm. long, ovate, obtuse, recurved-spreading; capsule blackish, depressed-globose, 5 mm. in diameter.

Between Guanai and Tipuani, Apr.–June, 1892 (1380).

The species appears intermediate between one collected by Mathews (no. 1951), one by Linden (New Grenada no. 1492) and one by Pearce (Moro, Jan., 1866).

Hamelia patens Jacq. Stirp. Amer. 74. *pl. 50.* Espirito Santo, 1891 (1222) = Rusby's 2105.

Bertiera Guianensis Aubl. Pl. Guian. 1: 180. *pl. 69.* Between Tipuani and Guanai, Dec., 1892 (1712) = Rusby's 2118.

Amaioua corymbosa H. B. K. Nov. Gen. 3: 419. *pl. 294.* Between Tipuani and Guanai, Dec., 1892 (1655).

GUETTARDA ALBICAULIS sp. n.

Branches elongated, terete, whitish, the flowering branchlets short, stout, rough with numerous leaf-scars; stipules brown and subscarious, 5 mm. long, triangular-ovate, very acute, connate; petioles about 2 mm. long, very stout, pubescent; blades 4–7 cm. long, 2–4 cm. broad, ovate, abruptly short-pointed, obtuse, the margin obscurely sinuate; thick and coriaceous, dark-green, glabrous, with impressed midrib and 4 or 5 pairs of primaries above, softly pubescent, scrobiculate in the axils and with sharply prominent veins underneath; terminal internode of the flowering branchlet purple, striate, pilose, clavate, the peduncles axillary in its triangular-ovate acute bracts, 5–8 mm. long; flowers sessile, about 5–8; calyx 2 or 3 mm. long, 2 mm. long at the summit, lobed nearly to the middle, the teeth white-pilose, ovate, acutish; corolla pilose, white (?), the tube 8 mm. long, very slenderly infundibular, the lobes 3 mm. long, ovate, recurved; stamens equalling the tube; style nearly equalling the corolla-lobes, the flat

branches nearly 1 mm. long, oblong with rounded apex; fruit not seen.

Between Tipuani and Guanai, Dec., 1892 (1636).

Chomelia tenuiflora Benth.; Rusby, Mem. Torr. Bot. Club, 3: Part 3, 45. Between Tipuani and Guanai, Dec., 1892 (1738) = 342.

The characters of the fruit (mature ?) of this species, unknown until now, are as follows: Nearly 1 cm. long, 2–2.5 mm. broad, oblong, the base slightly narrower, the apex subtruncate, tipped by the conspicuous cup of the calyx-limb, which about equals the strongly recurved teeth, blackish, minutely hispidulous, irregularly and rather lightly costate, slightly curved.

Chiococca brachiata genuina Muell. Arg. Mart. Fl. Bras. 6: Part 5, 51. Mapiri, July–Aug., 1892 (1507).

Coffea Arabica L. Sp. Pl. 172. Mapiri (Cult.), July–Aug., 1892 (1560).

COUSSAREA RUDGEOIDES sp. n.

Glabrous; branchlets stout, somewhat flexuous, fleshy, the internodes 2–3 cm. long; stipules 3 or 4 mm. long, 4 or 5 mm. broad, the summit rounded; petioles proper scarcely perceptible; leaves 1.25–2.5 dm. long, .5–1 dm. broad, oval, abruptly short-acuminate at both ends, entire, bright green, thin but rigid, the primaries 10–13 pairs, intercommunicating about 5 mm. from the margin; cymose panicles mostly solitary at the summit, successively trichotomous, 5 or 6 cm. long, including the stout peduncles which comprise nearly half their length, 4 or 5 cm. broad, dilated at the branching-points, the bracts and bractlets wanting, the flowers sessile or very short-pedicelled; calyx turbinate-campanulate, 4-angled, truncate, the border obscurely sinuate; expanded corollas not seen, in the bud 6–8 mm. long, lance-oblong, the lobes free at the tip.

Between Tipuani and Guanai, Dec., 1892 (1666.) Very near Spruce's 2486.

Faramea salicifolia Presl. Symb. Bot. 24. *pl. 70.* Between Tipuani and Guanai, Dec., 1892 (1684) = Rusby's 2626.

Faramea anisocalyx Poepp. & Endl. Nov. Gen. et Sp. 3: 28. Between Tipuani and Guanai, Dec., 1892 (1641) = Spruce's 4873.

Mapourea brachypoda Muell. Arg. in Mart. Flor. Bras. 6: Part 5, 422. Between Tipuani and Guanai, Dec., 1892 (1710) = Rusby's 1882.

MAPOUREA PALLESCENS sp. n.

Glabrous; branchlets stoutish, the internodes 3–4 cm. long; stipules 7 or 8 mm. long, ovate with rounded apex, entire, brown, caducous; petioles about 1 cm. long; blades .75–1.5 dm. long, 4–8 cm. broad, oval, both base and apex very slightly produced, but obtuse, thickish, very pale, the 10–12 pairs of primaries widely diverging and only slightly falcate-ascending; peduncles 5 or 6 cm. long, erect, stout, green, sulcate; cyme and its branches umbelliform, about 4 cm. long by 6 cm. broad, the rigid bracts extremely short, the flowers sessile; calyx campanulate, barely 1 mm. long, 1.5 mm. broad, the margin truncate, entire or barely sinuate; corolla 8 mm. long, in bud obovoid-pyriform with truncate apex, the lobes 3 mm. long, oblong, the apex rounded, in the bud slightly inflexed; filaments inserted in the pilose throat, very short, the anthers oblong, 1.5 mm. long, a little surpassing the base of the lobes; style much exserted, its branches as long as the anthers, spatulate-oblong; fruit not seen.

Between Tipuani and Guanai, Dec., 1892 (1675). Very near Schomburgk's Brit. Gui. 1708 B.

Mapourea? Apparently an undescribed species of this genus, but the specimens present only fruit in a very immature state. Between Tipuani and Guanai, Dec., 1892 (1693 and 1714) = Rusby's 1883.

Mapourea sp.? A positive generic determination cannot be given in the absence of fruit. If a *Mapourea*, it is not published. Between Tipuani and Guanai, Dec., 1892 (1670).

Psychotria cuspidata Bredem. ex R. & S. Syst. Veg. 5: 192. Between Guanai and Tipuani, Apr.–June, 1892 (1713). Apparently = Rusby's 2112.

Psychotria flexuosa Willd. Sp. 1: 966. Between Tipuani and Guanai, Dec., 1892 (1653) = Matthews, Peru, 1488.

Psychotria tabacifolia Muell. Arg. in Mart. Fl. Bras. 6: Part 5, 236. Espirito Santo, 1891 (1204) = Rusby's 1880.

Psychotria tomentosa (Willd.) Muell. Arg. in Mart. Fl. Bras. 6: Part 5, 370. Between Guanai and Tipuani, Apr.–June, 1892 (1469) = Rusby's 853, 854 and 855.

Psychotria.—Between Tipuani and Guanai, Dec., 1892 (1649). A positive determination of this plant must await the publication of Part IV.

PSYCHOTRIA TRIVIALIS sp. n.

Glabrous; branchlets slender, lax; stipules 2 or 3 mm. long, triangular-ovate, acute, deciduous; leaves .5 to 1 dm. long, 2–3 cm. broad, oblong-ovate, the base tapering into a short petiole, the apex abruptly acuminate, acute, entire, thin, pale, the primaries 6 or 8 pairs, strongly ascending; peduncles solitary, terminal, 1–3 cm. long, sharply angled, the panicles 3 or 4 cm. long and broad, trichotomous, the very slender pedicels 2 or 3 mm. long; flowers not seen; fruit at maturity depressed-globose, 4 or 5 mm. broad, the calyx-limb deciduous, bright red, the seed light brown, deeply sulcate.

Espirito Santo, 1891 (1186)=Schlimm's No. 584, from New Granada, 4,000 ft.

PSYCHOTRIA LUXURIANS sp. n.

Glabrous, except the minutely puberulent inflorescence; branchlets elongated, ascending, somewhat quadrangular; stipules connate, 6 or 7 mm. long and broad, triangular, acute, entire; leaves 1.25–2.5 dm. long, .5–1 dm. broad, oval, the base very abruptly acuminate into a short petiole, the apex similarly pointed; entire, bright green, pale underneath, very thin, the primaries about 16 pairs, falcate-ascending; peduncles .8–1 dm. long, purplish, quadrangular, the panicle 1–2 dm. long, 1–1.5 dm. broad, pyramidal, obtuse, loose, the rhachis flexuous, the branches divaricate, the bracts linear-oblanceolate, herbaceous, 1–1.5 cm. long; flowers actually sessile, but mostly appearing pedicelled by terminating the branchlets; bud ovoid, with rounded apex; calyx green, turbinate-campanulate, 1.5 mm. long, toothed midway, the teeth acute, tardily, if at all, deciduous; corolla infundibular, about 4 mm. long, the ovate, obtusish lobes 1.5 mm. long; fruit 3 or 4 mm. long, deeply sulcate.

Between Tipuani and Guanai, Dec., 1892 (1741) = Mathews, Peru, 1167. Very near *P. platyphylla* DC.

Psychotria rigida Kunth, Nov. Gen. 3: 289. Var. BREVIPES var. nov.

Differs from the type in the petioled leaves and very short and stout branchlets, peduncles and branches of the panicle, all of which are blackish.

Between Tipuani and Guanai, Dec., 1892 (1667).

Psychotria—specimen not matched at Kew, but cannot be determined without flowers. Espirito Santo, 1891 (1184).

Psychotria—unfit for determination. Between Tipuani and Guanai, Dec., 1892 (1727).

Palicourea riparia Benth. Hook. Journ. Bot. 3: (1841) 224. Espirito Santo, 1891 (1243).

RUDGEA VALIDA sp. n.

Tomentose, except the short-strigose upper leaf-surfaces; branchlets stout; stipules 1.5 cm. long, lanceolate, tapering to an acute point, inequilateral, connate about one-third of their length; petioles scarcely 1 cm. long, very broad; blades 1.5–2 dm. long, 6–8 cm. broad, with short-acuminate base and apex, thickish, rigid, the primaries 18–20 pairs, slender, regular and parallel, falcate, prominent, especially beneath where they are connected by the irregularly reticulate secondaries; peduncle terminal, stout, quadrangular, about half as long as the rhachis; panicle dense, not equalling the leaves, its bracts lance-linear, thin, the longest about 5 mm. long; flowers sessile, the calyx very short, the teeth about as long as the tube, broadly ovate, acute; corolla-tube cylindraceous, 4 mm. long, the strongly recurved lobes 2 mm. long; fruit not seen.

Mapiri, July to August, 1892 (1564). = Mathews' Peru, 1494, and near Kallbreyer's Antioquia, 1647. Species near *R. viburnoides* Benth.

Endlichera umbellata (Spreng.) Schum. Mart. Fl. Bras. 6: Part 6, 38. Between Guanai and Tipuani, Apr.–June, 1892 (1467) = 1000.

Borreria verticillata (L.) Meyer, Prim. Fl. Esseq. 83. *pl. 1.* Between Guanai and Tipuani, Apr.–June, 1892 (1341) = Rusby's 1401

RICHARDIA CRUCIATA sp. n.

Sparingly and coarsely setose-hispid; root stout, vertical, branching; stems 1–3 cm. long, ascending from the stout crown, branching from the base; setae of the stipules few, whitish-cartilaginous, 1.5 mm. long; leaves closely sessile, 1–1.5 cm. long, 4–8 mm. broad, ovate-oval, acute, strongly revolute, thick and rigid, bright green, 3–4-nerved, the nerves impressed above, very prominent underneath; flowers terminal, closely sessile, few; calyx-tube lanceolate, 2 mm. long, the lobes of equal length, lance-linear, very acute, setose-tufted at the apex; corolla-tube infundibular, 3.5 mm. long, the lobes a little shorter, ovate, acute; stamens reaching about to the middle of the corolla-lobes; style capillary, about as long as the corolla-lobes, the stigma large, capitate, 4-lobed; fruit 4-coccous.

I was at first inclined to regard this as a *Diodia*, in spite of the fruit structure, which is typical of *Richardia*; but Mr. N. E. Brown has kindly corrected me and shown that this, as well as *D. tetracocca*, which it resembles, belongs in *Richardia*.

Near snow-line, Mt. Tunari, 1891 (1034).

GALIUM COCHABAMBENSE sp. n.

Stems very slender, whitish, strongly quadrangular, sulcate, retrorsely hispid; leaves sessile, 1.25–2.25 cm. long, 1.5–2.5 mm. broad, linear-oblong, acute, pale, 1-nerved, retrosely hispid on the margin and less so on the midrib; peduncles terminal, mostly 2, 2- or 3-flowered, the pedicels divaricate, stoutish, 3–5 mm. long; corolla 1.5 mm. long, the lobes broad, ovate, rounded; fruit not seen.

Vic. Cochabamba, 1891 (1145).

VALERIANEAE.

Valeriana andina Britton, Bull. Torr. Bot. Club, 17: 264. Near snow-line, Mt. Tunari, 1891 (1030) = Rusby's 878.

Valeriana Boliviana Britton, Bull. Torr. Bot. Club, 17: 263. Vic. Sorata, May, 1892 (1300) = Rusby's 871, 875, 1237, etc.

Valeriana, apparently an undescribed species near *V. scandens*, but plant too young. Vic. Sorata, May, 1892 (1319).

COMPOSITAE.

Vernonia laurifolia DC. Prod. 5: 30, *fide* Dr. L. Radlkofer. Mapiri, July–Aug., 1892 (1534) = 617 and (?) Rusby's 1617.

Vernonia arborescens Swz. Fl. Ind. Occ. 2: 1320. Espirito Santo, 1891 (1207).

Vernonia, apparently *V. missionis* Gardn. Hook. Lond. Journ. Bot. 6: 422, in a young state. Between Guanai and Tipuani, Apr.–June, 1892 (1420) = Traill's 453 from upper Brazil.

VERNONIA BANGII sp. n.

(*Lepidoploa scorpioideae verae.*) Summit of stem only seen, Robust, apparently erect, simple, corymbosely branched above, the inflorescence in my specimen nearly 3 dm. high and broad; puberulent throughout, except the upper leaf-surface, which is scabrate; stem finely angled; upper leaves on stoutish petioles 2–3 cm. long, the blades 1.5–2 dm. long, by 5–7 cm. broad, narrowly and regularly ovate, with rounded or obscurely produced base, regularly tapering to the acute apex and with the lightly revolute margin distantly serrate, the teeth reduced to minute blunt mucros; texture thickish, somewhat rigid, veins slightly prominent, reticulated, elevated both sides, the primaries 15 to 20 pairs; floral leaves few and large; heads closely sessile, rather loosely arranged along the slender sharply angled ultimate branchlets, dull grayish yellow, about 7 mm. high and broad; involucre hemispherical, 4 mm. high and a

little broader, the scales 40–60, in 4 or 5 series, dirty yellowish-white with broad green middle portion, thick and rigid, the appressed or slightly recurved apex obtuse to rounded; bristles of the pappus rather few and stout, nearly 3 mm. long, a little exceeding the infundibular tube of the corolla, the lobes of which are lanceolate, acutish, 1.5 mm. long; akenes (immature) black, less than 1 mm. long, nearly as broad.

Between Mapiri and Tipuani, July–Aug. 1892 (1483).

Species near *V. Pacchensis*.

VERNONIA COSTATA sp. n.

(*Lepidoploa scorpioideae verae.*) Stout, widely branching, the inflorescence loosely paniculate; branches about 8-angled, ferruginous and slightly cinereous, those of the inflorescence ferruginous only; only the upper leaves seen, their petioles 2 cm. long, 5 mm. broad, the blades 2–2.5 dm. long, 7–8 cm. broad, lance-ovate with sub-rotund base, acute apex and almost imperceptibly sinuate-dentate margin, very thick and rigid, above finely strigose, ferruginous on the veins, underneath silvery or slightly yellowish, very softly tomentose; midrib slightly impressed above and, like the 20–25 pairs of primaries, extremely strong and prominent beneath, the latter connected very close to the margin; heads sessile, at length loose, 8 or 9 mm. long; involucre open-campanulate, 6 mm. long, the scales in 4 or 5 series, loosely imbricated, the inner series very much longer, lanceolate, keeled, pungent, purplish-brown, lightly white-hairy; pappus-bristles white, acute, faintly scabrous, 4 mm. long, the outer complanate; corolla light purple, variously shaded with yellow, the slender tube 4.5 mm. long, the narrow lobes 1 mm. long; style-branches yellow.

Mapiri, July–August, 1892 (1472).

VERNONIA JUBIFERA sp. n.

(*Critoniopsis?*) White-tomentose, the stem and branches densely shaggy, the upper leaf-surfaces scabrous; stems apparently tall and widely branching, terete or nearly so, the inflorescence open-paniculate; leaves amplexicaul, with blunt or rounded auricles 1–1.5 cm. long and broad, oval to slightly ovate, or obovate, the lower fourth contracted somewhat abruptly, the apex abruptly short-acuminate, obtuse, the margin irregularly and very lightly crenate-dentate; not coriaceous, the veins lightly impressed above, elevated beneath, crooked and slender except the midrib, which is very stout, reticulate, the primaries 15–18 pairs, lightly ascending and inter-arched near the margin; heads sessile and crowded on the short branchlets, mostly in threes, nearly 1 cm. long; involucre turbinate-campanulate, about 4 mm. long and broad, the scales in 4 or 5 series, loosely imbricated, tawny and variously

tinged with purple, especially the inner which are successively much longer, lanceolate, obtusish, straight, concave, thick and rigid; pappus 4 mm. long, rather copious, fine, white; corolla bright purple, the tube infundibular, slender, 3 mm. long, the lobes narrow, 1.5 mm. long; style-branches purple; akene brown, faintly hispid, 2 mm. long, .5 mm. broad at the apex, tapering to .25 mm. at the base.

Between Mapiri and Tipuani, July–Aug., 1892 (1554).

VERNONIA TRIXIOIDES sp. n.

(*Paniculatae.*) Apparently erect and sub-simple, rather slender, paniculately branched at the summit, glabrous except the inflorescence, the stem brown, finely many-angled, the branchlets of the inflorescence green, very strongly few-angled; petioles 1–2 cm. long, strongly flattened, the base somewhat dilated; blades about 1.5 dm. long, 5–6 cm. broad, lance-ovate with rounded base, regularly acuminate and acute apex and serrate margin with distant small strongly appressed spinulose teeth; green, membranaceous, venation not prominent, faintly reticulate, the primaries about 10 pairs, moderately curved; panicle naked except for a few small subulate bracts, several dm. high. 2–3 dm. broad, open, the branches at about 45°, slender; peduncles slender, .5–1.5 cm. long, one-bracted near the involucre, bearing solitary heads nearly 2 cm. long; involucre 1 cm. long and broad, or broader, hemispherical-campanulate, the bracts in 5 or 6 series, appressed, ovate, abruptly short-acuminate and pungent, 1-nerved, slightly concave, green with yellowish margin, puberulent and ciliate; pappus-bristles unequal, 6–9 mm. long, copious, fine, white, acute, minutely scabrous, the outer similar, ¼ to ⅓ as long; corolla bright purple, the tube 7 or 8 mm. long, the limb 4 mm. long; akene dark brown, 2 mm. long, strongly 8-or 10-costate, the ribs densely white-bearded.

Mapiri, July–Aug., 1892 (1484).

VERNONIA ROBUSTA sp. n.

(*Lepidoploa scorpioideae foliatae axillares.*) Stem stout and coarse, much and widely branched, the branchlets thickish but weak, elongated, strongly ascending and sub-drooping at the ends, flexuous, canescent; petioles flat, very short and nearly as broad, the blades (lower not seen) 7–10 cm. long, 3–5 cm. broad, irregularly and inequilaterally oval to ovate, with rounded base, abruptly acute apex and revolute, very obscurely sinuate-dentate margin, brownish green, above scabrous, underneath harshly tomentellate, thick, rigid, of very coarse texture, strongly rugose; the midrib, 8–10 pairs of primaries, and few secondaries very prominent, coarsely reticulate; floral leaves similar, ¼ to ⅓ as large; heads 2–3 cm. apart, solitary in the axils, very large, about 2 cm.

long; involucre sub-globose, or broadly campanulate with contracted mouth, 1 cm. long, 12–14 mm. broad, squarrose, the scales in 6 or 7 series, canescent, green with purple tips, margins and veins, ovate, acuminate and acute, rigid; pappus 8 mm. long, tawny, coarse, blunt, serrate, the outer sub-paleaceous, nearly 1 mm. long; corolla purple, the slender tube 7 mm. long, tomentose, the limb 4 mm. long; anthers dull white, large, much exserted; akene (immature) 4 mm. long, light brown, sparsely hispid, the 10 very strong ribs black-tipped.

Between Guanai and Tipuani, April to June, 1892 (1424).

Near Glaziou's 18,328 and Pearce's specimen of *V. macrophylla.*

Piptocarpha Lechleri (Sch. Bip.) Baker, in Mart. Fl. Bras. 6: Part 2, 127 in obs. (*Carphobolus L.*, Sch. Bip. Pollichia [1863] 428).

Mapiri, July–Aug., 1892 (1506) = Lechler's 2479.

STEVIA GRANDIDENTATA Sch. Bip. Bull. Soc. Bot. Fr. 12: (1865) 81. Name only.

Hispidulous-pubescent throughout, the upper leaf-surface strigose; tall, erect, simple or corymbosely branched at the summit; upper leaves only seen, opposite, their petioles 1–2 cm. long, margined, dilated and sub-connate at the base; blades 5–8 cm. long, 2.5–4 cm. broad, angularly ovate, the base rounded, in the smaller very abruptly contracted into the margined petiole, in the lower probably becoming cordate, the apex obtusish to obtuse, the margin bluntly and rather coarsely dentate, pale, the veins reticulate and rather sharp underneath; floral leaves similar, becoming gradually smaller, the floral branchlets subtended by lanceolate bracts; heads very numerous, densely crowded at the ends of the branches, deep purple, 11–12 mm. long; involucre 6 mm. long, deep purple, the base green, akene (immature) 4 mm. long, very slender, sharply 5-angled, glabrous; pappus of 5 very small ovate acute scales, less than .5 mm. long; corolla 7 mm. long, narrowly funnel-form, the lower portion of tube 2 mm. long, dark, pilose, the upper much broader, glabrescent, the limb 1 mm. long.

Vic. Cochabamba, 1891 (1149).

Exactly the same as Mandon's no. 245.

STEVIA OBOVATA sp. n.

Stem very short, branching from the base, the branches several, 1.5–2 dm. long in my specimens, ascending, slender, sinuous, branched from the upper axils, very leafy at the base, with elongated internodes above, terete, dark purple, pubescent above; leaves sessile, 2–3.5 cm. long, 8–12 mm. broad, obovate to oblanceolate with blunt apex and slightly sinuate-dentate

margin, thickish, dark green, sparsely hairy on the veins beneath and ciliate, the veins very prominent on both sides, irregularly reticulate; corymbs dense, 1.5–3 cm. broad; heads 1 cm. long, the involucre 5 mm. long, deep purple, of 4 oblanceolate acutish pubescent scales; akene (in flowering stage) 3 mm. long, whitish, sharply angled; pappus of unequal aristate paleæ, the shorter .5 mm., the longer 1.5 mm. long; corolla-tube infundibular, 4 mm. long, 1 mm. broad at the apex, dark-purple, sparsely hairy, the lobes oval-elliptical, nearly 2 mm. long, light purple with lighter margins.

Vic. Cochabamba, 1891 (1027).

The same as Spruce's 5042, etc. although the corollas of the latter are smaller.

Eupatorium conyzoides Vahl, Symb. 3: 96. Espirito Santo, 1891 (1208). Between Guanai and Tipuani, Apr.–June, 1892 (1444) = Rusby's 1621 and 1624.

Eupatorium glomeratum DC. Prod. 5: 154. Mapiri, July–Aug. 1892 (1514).

Eupatarium sordescens DC. Prod. 5: 167. Var. BOLIVIANUM var. nov. Differs from the type in being ferruginous and in the longer black akenes with more tapering base.

Between Guanai and Tipuani, Apr.–June, 1892 (1464).

EUPATORIUM BANGII sp. n.

(*Praxelis.*) Branched from near the base, the branches apparently sub-ascending, 3–5 dm. long, the stems green, angled, pubescent and slightly harsh, the upper internodes dilated at the summit; leaves 4–8 cm. long, 1.5–3 cm. broad, angularly ovate with acute apex, sub-cuneate base narrowed into a short margined petiole and distant coarse short teeth; above strigose-hispidulous, underneath pale and sparsely pilose, 3-nerved and sparsely veiny; peduncles elongated, strongly angled, stout, enlarged at summit, cymose, naked, or with a pair of foliar leaves; heads solitary, at maturity nearly 1.5 cm. long and broad; involucre 1 cm. long, regularly campanulate, the scales in 5 or 6 series, imbricated and closely appressed, the outer successively shorter, obovate to spatulate, with rounded bright purple tips, conspicuously 3–7-nerved; involucre slightly convex, foveolate, hollow; akenes curved, 4 mm. long, stout, black, with 5 very strong and sharp white hispid angles; pappus single, sub-equal, 5 mm. long, coarse, sharply serrate, obtuse, dull white; corolla purple, the tube infundibular, 4.5 mm. long, the lobes .5 mm. long; anther-appendages manifest, and like the style-branches, little exserted.

Vic. Cochabamba, 1891 (1133).

Species near *E. liatridea* and *E. Guanaiense*. Also collected in Bolivia by Bridges.

EUPATORIUM CONNIVENS sp. n.

Shrubby, much branched, the branches strongly ascending, dark brown, striate, the branchlets erect, slender, green, few-angled, scabrellate-pubescent; leaves subsessile, 3–6 cm. long, 1–2.5 cm. broad, ovate to lance-ovate, with regularly tapering obtusish apex, base abruptly contracted into a very short petiole-like portion, and distantly and coarsely serrate margin, above scabrous, underneath prominently reticulate, and sparsely and harshly hairy on the veins, somewhat 3-ribbed; heads closely aggregated upon the erect branchlets, either sessile or upon short peduncles dilated at the summit, 1.5 cm. long; involucre 1 cm. long and 3–4 mm. broad, cylindraceous, the scales in many series, the outer successively shorter, closely appressed, obovate-spatulate with regularly rounded purple apex, nerved, the innermost linear-oblanceolate and obtuse; involucre very small, conical, about 15-flowered; akene 4.5 mm. long, black, with sharp white angles; pappus 6.5 mm. long, scanty, unequal, tawny, minutely serrate; corolla-tube 6 mm. long, the lobes a little over 1 mm. long.

Vic. Cochabamba, 1891 (1114).

Near *E. paucidentatum* Sch. Bip., but much more robust and with heads much longer. The same as Mandon's 248. Also collected by Bridges in Bolivia.

EUPATORIUM VENOSISSIMUM sp. n.

Tall and coarse, widely and laxly branching; stem sinuous, purple, finely angled, the branches similar, lighter, slender, the branchlets pale-green, minutely hispidulous; petioles .5–1.5 cm. long, margined, at the base, abruptly dilated and connate; blades 5–12 cm. long, 2–5 cm. broad, ovate to lance-ovate, with subrotund to slightly produced base, regularly tapering acute apex and coarsely and sharply serrate margin, thin, pale, minutely scabrate and very sparsely hairy both sides, 3-ribbed and prominently veiny both sides, especially so beneath, the veins whitish; heads corymbed, the corymbs loosely branched, but the heads closely crowded on the ultimate branchlets, mostly short-peduncled, the peduncles pubescent; heads 3.5–4 mm. long, the involucre nearly equalling the pappus, the scales about 8, loosely imbricated, ovate-oblong, obtuse, pubescent, 3–5-nerved; receptacle 5-flowered; akene (very immature) short, pubescent; lower third of corolla abruptly much contracted, strongly pubescent, the upper portion cylindraceous, yellowish, with very short erect lobes.

Vic. Cochabamba, 1891 (1113).

Near *E. laeve*.

Willoughbya cordifolia (L.) Kuntze, Rev. Gen. Pl. 372. Between Guanai and Tipuani, Apr.–June, 1892 (1497).

Willoughbya hirsutissima (DC.) Kuntze, Rev. Gen. Pl. 372. Between Guanai and Tipuani, Apr.–June, 1892 (1331).

Willoughbya psilostachya (DC.) Kuntze, Rev. Gen. Pl. 372, in syn. Between Tipuani and Guanai, Dec. 1892 (1730) = Rusby's 1701, 1702 and 1703.

Willoughbya scandens (L.) Kuntze, Rev. Gen. Pl. 372. Espirito Santo, 1891 (1267.) A form near var. *barbinervia*.

WILLOUGHBYA DIOSCOREOIDES sp. n.

Branches stout, purplish brown, finely and sharply many-angled, glabrous; petioles (only two seen) 4 cm. long, dark purple, verrucose, the blades 2 dm. long, 1.5 dm. broad, ovate with beautifully rounded base, abrupt apical acumination 1–2 cm. long, and entire slightly revolute margin, coriaceous, glabrous both sides, very pale above and brownish beneath, 5-ribbed from near the base, the lower pair of ribs less stout, soon marginal, a trace of a third pair at the margin of the base, the veins obscure above, rather prominently reticulate beneath; panicle of indefinite size, in my specimen 6 dm. long including the long peduncle, very loose and open, its lower branches 1 dm. apart, the latter at the base laterally keeled and abruptly upwardly and downwardly dilated, the lower dilation adnate to the petiole of the floral leaf, the upper to the parent branch; floral leaves small, on broad connate ferruginous-tomentose petioles; branchlets of the inflorescence ferruginous, subtended by subulate bracts; heads sessile and solitary in loose interrupted spikes about 3 cm. long, subtended by subulate bractlets nearly half their length, 2.5 mm. long, 1 mm. broad, pear-shaped in the bud, campanulate when expanded, the pappus and corolla scarcely equalling the involucre; scales oblong, obtuse, chartaceous, light brown, 3-costate; akene blackish, with minute whitish costae, stout, oblong-obovoid, nearly half the length of the corolla; pappus copious, white, coarse; corolla-tube proper about one-half the length of the upper portion.

Vic. Cochabamba, 1891 (1256).

Species very near *W. Bangii* Rusby, but differing particularly in the form of involucre and its scale-characters and the relative length of the flowers.

WILLOUGHBYA FERRUGINEA sp. n.

Climbing, stems sharply many-sulcate, and like the petioles and principal veins on the underside, densely hirsute with ferru-

ginous hairs; branchlets articulated by an enlarged terete base; petioles 1–1.5 cm. long, broad, their bases much dilated, connate; blades 7–10 cm. long, 3–5 cm. broad very near the base, somewhat inequilateral, ovate with regularly tapering acutish apex, sub-cordate base and entire margin, bright green, above glabrous, with obscure veins, underneath ferruginous with prominent veins, the primary only 3 pairs, with many faint intermediate ones; peduncles of the axillary panicles approximately as long as the floriferous portion, which is 7–12 cm. long, 5–7 cm. broad, pyramidal, moderately dense, lanceolate-bracted; heads 3–5, 8 mm. long, sessile and crowded at the ends of slender branchlets slightly longer than themselves, subtended by broadly ovate serrate branchlets about two fifths as long as the involucre; involucre 6 mm. long, the scales oblong-oblanceolate, the apex rounded and ciliate, finely 5-nerved, with scarious margins, nearly glabrous; akenes black with very fine whitish angles, 3.5 mm. long, little tapering at the base; pappus 3.5 mm. long, copious, tawny, the serration scarcely perceptible; corolla-tube blackish, 1.25 mm. long, from an abruptly dilated base, very narrow, the limb 2 mm. long, broadly campanulate, the lobes 1 mm. long, broadly ovate.

Between Guanai and Tipuani, Apr.–June, 1892 (1419). The same as Jameson's 5095. Very near *W. Pohliana*, but that has a glabrous stem.

WILLOUGHBYA LONGIACUMINATA sp. n.

Branches stoutish, finely many sulcate, and, like the branchlets, petioles and veins on lower surface ferruginous-tomentellate; petioles 1–2 cm. long, broadly margined, at the base slightly dilated and connate; blades 7–12 cm. long, 2.5–4 cm. broad near the base, ovate with rounded base, regularly long-acuminate and very acute apex, and entire margin, minutely ferruginous both sides, thickish, bearing three pairs of rib-like primaries from the lower fourth, the upper primaries mostly obscure, angularly reticulate with the former and with one another, the veins slightly impressed above and prominent underneath; panicles solitary in the axils, the lower shorter, the upper much longer than their leaves, pyramidal, somewhat loose, lanceolate-bracted, the peduncles one-half as long as the floriferous portion, the heads at length crowded, sub-sessile, 4 mm. long and one-half as broad, subtended by a bract 1 mm. long and broad; involucral scales obovate, cartilaginous, whitish with green middle portion, finely many-nerved, the terminal portion thin, fimbrillate, tending to become recurved or spreading, the shorter pair about equalling the flowers; akene .5 mm. long, more than one-half as broad, very hairy; pappus 2.5 mm. long, coarse, tawny, equalling the corolla.

Mapiri, July–Aug., 1892 (1504).

Near *W. laevis*. Nearly the same as a specimen collected by Holton (no. 344), but in that the pappus much exceeds the involucre.

GRINDELIA BOLIVIANA sp. n.

Glabrous, very pale or glaucous, erect or ascending, 4 dm. high, or more, freely branching from the base upward, the branches erect, and like the stems irregularly and roughly angled; leaves 5–8 cm. long, 1.5–2 cm. broad, lance-oblong from a broad clasping and slightly decurrent base, with acute and mostly pungent apex and coarsely, strongly pungently serrate margin, midrib prominent, the veins obscure, very finely and very strongly reticulate; heads terminal, solitary, nearly 2 cm. long; involucre a little more than 1 cm. long, nearly 2 cm. broad, hemispherical-cupulate, the margin little if at all contracted; scales very loosely imbricated, the outer linear, wholly herbaceous, thick, drooping or loosely spreading, the inner lanceolate, middle and upper portions green, the latter loosely spreading; rays about twice the length of the involucre, one-third longer than the disk, deep yellow, oblanceolate, strongly 8–10-nerved, slightly notched; akenes (of the disk) 2 mm. long, 1 mm. broad, strongly compressed, the margins dilated; awns mostly 5, 6 mm. long, acicular, pungent; corolla 5.5 mm. long; appendages of the style triangular.

Vic. Cochabamba, 1891 (1055).

Near *G. pulchella* Dunal.

Laestadia Lechleri Wedd. Chlor. And. 1: 184. Vic. Mapiri, 12,000 ft., Sept., 1892 (1576) = Rusby's 2667.

Erigeron hieracioides Wedd. Chlor. And. 1: 194. Espirito Santo, 1891 (1219) = Rusby's 2716 and 2717.

Baccharis trimera DC. Prod. 5: 425. Vic. Sorata, 1892 (1313) = 692, and Rusby's 1564.

Baccharis trinervia (Lam.) Pers. Syn. 2: 423. Espirito Santo, 1891 (1202). An extreme form, with ovate acuminate leaves.

BACCHARIS DEBILIS sp. n.

Herbaceous, glabrous, the stems erect, very slender, 5 dm. high, or more, with 3–5 strong angles and twice as many secondary ones, the branches similar, strongly ascending; petioles 3–7 mm. long; blades 5–15 cm. long, .7–2.5 cm. broad, lance-ovate, with acute base gradually contracted into the petiole, long regularly acuminate and acute apex, and lightly sinuate, shortly ciliate margin, thin but rigid, dark green, 3-nerved, the midrib lightly impressed above, prominent beneath, veins moderately prominent beneath, reticulate; cymes few and small, loose with few heads,

linear-bracted, the peduncles 3–10 mm. long; heads small, the involucres broadly hemispherical-campanulate, 2 mm. long, 3 mm, broad, the scales in 2–4 series, few, loosely imbricate, lanceolate, acute, white, with lacerate margin and green midrib; receptacle convex, strongly foveolate. *Pistillate flowers:* akene hispid, .75 mm. long; pappus 2 mm. long, slender, rather sparse; corolla 2 mm. long; style-branches .3 mm. long, erect, linear, acute. *Sterile flowers:* akene wanting; pappus similar to last, but more serrate, 2 mm. long; corolla 2 mm. long, broadly campanulate, deeply lobed; style not exserted (but the flowers are not yet fully developed).

Between Guanai and Tipuani, April–June, 1892 (1457).

Species near *B. salicifolia*, but the heads are broader and the leaves more acuminate.

BACCHARIS MAPIRENSIS sp. n.

Fruticose or suffruticose, sub-glabrous, much branched, the branches somewhat flexuous, greenish, sharply and irregularly 4–5-angled, the branchlets short, divergent; petioles 1–5 mm. long, margined; leaves 3–7 cm. long, 1–2.5 cm. broad, lanceolate, with sub-rotund base, acuminate acute apex and entire margin, slightly thickish, very minutely and sparingly pulverulent beneath, the midrib lightly impressed above and prominent beneath, the veins rather obscure, primaries 6–10 pairs, intercommunicating some distance from the margin; floral leaves successively smaller; inflorescence loosely and irregularly paniculate-cymose, the branches very strongly angled, the bracts lanceolate-subulate, thickish; heads on slender peduncles mostly equalling their own length, 5 mm. long, 7 or 8 mm. broad in full flower, tawny; involucre campanulate-hemispherical, 3 mm. long, 4 mm. broad, the scales in 2 or 3 series, imbricate, closely appressed, lance-ovate, obtuse or obtusish, middle portion green, margins broad, white, ciliate; receptacle convex, foveolate, the margins of the pits fimbrillate; hermaphrodite sterile flowers only seen; akene none, pappus very scanty; corolla-tube 1 mm. long, limb 2 mm. long, its lobes 1 mm. long, narrow; essential organs much exserted, erect; style-branches projecting nearly 1 mm. beyond the anthers, 1 mm. long, connivent, subulate.

Between Mapiri and Tipuani, July–Aug., 1892 (1481).

BACCHARIS OBLANCEOLATA sp. n.

Fruticose or arborescent, glabrous, except the puberulent inflorescence; branches stout, leafy, grayish or reddish-brown, angled above, little branched; leaves scarcely petioled, 6–10 cm. long, 2–3 cm. broad, oblanceolate, with acute base, abruptly short-acuminate and acute apex and entire margin, slightly inequilateral, thick-

ish, above dark green, below pale and minutely black-dotted, the midrib rather prominent on both sides, veins obscure both sides, the primary about 8–10 irregular pairs; panicles 1–1.5 dm. long, 1.5–2 dm. broad, loose, the branches nearly divaricate, the lower branches subtended by foliage leaves, the branchlets by small and delicate subulate bracts; heads strongly divergent, on peduncles 2–6 mm. long; heads 4–5 mm. long, 5–6 mm. broad, tawny; involucre campanulate-hemispherical to broader, two-thirds the length of the head, the scales few, in two series, broadly ovate, obtuse, the middle green, the margins white and fimbriate; receptacle conico-hemispherical, brown, strongly foveolate; sterile flowers only seen; akene (in flower) very small, pappus sparse, 1-serialled, white, the apex slightly recurved, not thickened; corolla tube brown, 1 mm. long, the limb campanulate, 1.5 mm. long, yellowish, the lance-ovate lobes nearly 1 mm. long; anthers truncate or slightly emarginate at the base, with small triangular apical appendages; style-branches erect, broadly triangular, the apex of style recurved-exserted.

Mapiri, July–Aug, 1892 (1490). Very near *B. brachaelinoides*, but differs in the maculate leaves, of different form and nervation.

FACELIS CAPILLARIS sp. n.

A tomentose annual; stems 4–6 cm. high, very slender, reddish; leaves opposite, sessile, .5–1.5 cm. long, about 1 mm. wide when flattened out, linear or a little broader upward, acute, strongly revolute, the margins and midrib of a deeper green; heads axillary and terminal, only 2 or 3 mm. broad, the involucre lance-ovoid, the scales few, unequal, the longest about 5 mm. long, ovate, acutish or obtuse, the very hyaline margins as broad as the green middle portion; flowers apparently all fertile, about 5; akenes comparatively large, 1 mm. long, oval, light brown, their hairs developing a dense mass of mucilage when wetted; pappus fine, very slightly plumose, 4 mm. long; corolla 2 mm. long, very slenderly cylindrical, white, with brown contracted apex.

Vic. Cochabamba, 1891 (1144). A satisfactory dissection is difficult owing to the mass of mucilage which is developed.

GNAPHALIUM VERSATILE sp. n.

Root vertical, stout, woody; stems numerous, tufted, erect or ascending, slender, simple, 2–4 dm. high; indumentum fine, close, white, uniform throughout; leaves numerous, erect, mostly secund, sessile, 5–10 mm. long, 1–2 mm. broad, subulate, thickish; inflorescence capitate, globular or broader, 2–3 cm. broad, dense; heads 5 mm. long, somewhat broader, the pappus about equalling the campanulate involucre; scales uniformly whitish to light-brown, except the lower third which bears a bright green central stripe,

scarious, oblanceolate to obovate, obtuse or acutish, minutely and faintly many-nerved.

Near snow-line, Mt. Tunari, 1891 (1035). Also collected by Pearce at Pelechuco.

Clibadium Surinamense L. Mant. 2: 294. Espirito Santo, 1891 (1203) = Matthew's 1736 from Peru. This I believe to be one of several distinct species included under this name; but for the present I follow the Fl. Bras., and place it here.

Polymnia edulis Wedd. Ann. Sci. Nat. (IV.) 7: (1857) 114. Espirito Santo, 1891 (1229).

Acanthospermum hispidum (Less.) DC. Prod. 5: 522. Between Guanai and Tipuani, Apr.–June, 1892 (1445).

Acanthospermum humile (Less.) DC. Prod. 5: 522. Turedon, 1891 (1137).

Zexmenia, sp.? It appears probable that a new genus will have to be established for this species which, besides being rayless, has an involucre quite different from that of any known species of *Zexmenia*. For this reason I prefer not to assign it a specific name under this genus. At the same time, the unsettled state of the literature of this section of the Compositae forbids my proposing a new generic name.

Between Guanai and Tipuani, April–June, 1892 (1340).

Verbesina australis (Hook.) Baker in Mart. Fl. Bras. 6: Part 3, 215. A little below Cochabamba, 1891 (1003). Also collected by Pearce at Tarija, Bolivia.

VERBESINA CINEREA sp. n.

Cinereous and scabrous throughout; stems erect, stout, flexuous, 5 dm. high or more; leaves alternate, on very short stout petioles, or the upper sessile, 5–15 cm. long, 2–5 cm. broad, lanceolate to ovate, base mostly rounded, apex acutely pointed, coarsely and sharply serrate, strigose, coarsely veined, the midrib prominent both sides; heads stoutly peduncled, sub-globose, 1.5–2 cm. long; involucre sub-hemispherical, 1 cm. long, the scales in about 3 series, the outer shorter, oblong, obtuse or acute, thick and rigid, appressed, dark gray with very narrow light margins; receptacle convex; chaff enclosing the akene, hirsute and black above; akene black, 7 mm. long, 4 mm. broad exclusive of the narrow wing which is above broader and ciliate or lacerate; pappus of 2 rigid bristles 5 mm. in length, hispid; corolla-tube proper 2 mm. long, densely villous, the upper half abruptly con-

tracted, the limb 5 mm. long, cylindrical; style-branches of the disk flowers lightly villous toward the summit.

Below Cochabamba, 1891 (1092).

Salmea mikanioides Britton, Bull. Torr. Bot. Club, 19: 150. Mapiri, July–Aug., 1892 (1486). The same as Rusby's no. 1739.

Cosmos diversifolius Otto in Knowles & Weste. Fl. Cab. 2: 8. *pl. 47.* Near snow-line, Mt. Tunari, 1891 (1021). Vic. Sorata, May, 1892 (1302).

Bidens rubifolius H. B. K. Nov. Gen. 4: 237. *pl. 381.* Between Guanai and Tipuani, Apr.–June, 1892 (1406). The flowers are smaller and more deeply colored than in the type.

Galinsoga calva Rusby, Mem. Torr. Bot. Club, 3: Part 3, 61. Vic. Cochabamba (1148).

Calea robusta Britton, Bull. Torr. Bot. Club, 19: 151. Between Guanai and Tipuani, Apr.–June, 1892 (1423) = 429.

POROPHYLLUM OBLANCEOLATUM sp. n.

Glabrous, the base fruticose; flexuous, the elongated branches sub-erect, slender, green or purplish, irregularly costate; leaves sparse, 2–4 cm. long, 3–5 mm. broad, oblanceolate, tapering into an elongated petiole-like base, the apex blunt, entire; fleshy, pale green or some with purple midrib and narrow purple margin; floral leaves linear; heads solitary at the ends of elongated slender naked peduncles, which are abruptly dilated at the apex, 1.5 cm. long; involucre campanulate, 1.2 cm. long; the scales 5, free, green-purple with scarious imbricated margins, oblanceolate to obovate, blunt; akenes 5.5 mm. long, slenderly oblanceolate, black, angled, sparsely hispidulous; pappus unequal, 7 mm. long, distinct, white, slightly serrate; straight portion of corolla-tube 5 mm. long, the base abruptly dilated, the gradually dilated upper portion abruptly recurved, the lobes about 1 mm. long, ovate, acutely pointed, strongly spreading; essential organs exserted, conspicuous, deep purple.

Below Cochabamba, 1901 (1013). Species near *P. longifolium.*

Schkuhria abrotanoides Roth, Cat. 1: 116. Vic. Sorata, March, 1892 (1298) = 755.

TAGETES MANDONI Sch. Bip. Bull. Soc. Bot. France, 12: 79. Name only.

Stoutish, erect, 5 dm. high or more, very leafy, glabrous; leaves 5–10 cm. long, on very short petioles or with one or two reduced linear leaflets at the insertion, obovate; leaflets mostly 6½ pairs, the terminal largest, 3–7 cm. long, by 1–2 cm. broad, the

lower successively smaller, oblong, acute at both ends, incisely serrate, decurrent upon the rhachis, dark green above, yellowish-green and blackish glandular, with stout and prominent midrib beneath; inflorescence mostly compact, the heads 1.5 cm. long, 4–5 mm. broad, short-peduncled; involucre oblong-obovoid, the glands few, brownish, elongated, the teeth broadly ovate to semicircular and very slightly spreading; ray-corollas bright yellow, conspicuous, the tubular 6–7 mm. long, narrowly funnelform, blue-black; akenes 6 mm. long, very slender, sharply angled, minutely papillose; pappus 3 mm. long.

Near snow-line, Mt. Tunari, 1891 (1111). Same as Rusby's 1641.

Liabum hastifolium Poepp. & Endl. Nov. Gen. et Sp. 3: 43. Mapiri, July–Aug., 1892 (1475) = Rusby's 1742.

Liabum Rusbyi Britton, Bull. Torr. Bot. Club, 19: 263. Espirito Santo, 1891 (1195). Near Mapiri, 10,000 ft. Sept., 1892 (1581). The latter has smaller leaves than the type, less pointed and more oblong or oblanceolate.

Liabum ovatum (A. Gray) Britton, Bull. Torr. Bot. Club, 19: 263. (*L. uniflorum* Ball, Journ. Linn. Soc. 22: [1885] 46). Near snow-line, Mt. Tunari, 1891 (1045) = Rusby's 1633.

Senecio Sprucei Britton, Bull. Torr. Bot. Club, 19: 265. Mapiri, July–Aug., 1892 (1513) = Rusby's 1695.

Senecio Yungasensis Britton, Bull. Torr. Bot. Club, 19: 264. Mapiri, July–Aug., 1892 (1538) = Rusby's 1719.

Senecio culcitroides Wedd. Chlor. And. 1: 103. Espirito Santo, 1891 (1240) = Rusby's 1692.

SENECIO SINAPOIDES sp. n.

Stem tall, coarse, widely branching, angled, light green, the younger parts thinly floccose; lower leaves 1–2 dm. long or more, 5–8 cm. broad, ovate, tapering into a narrowly winged petiole, coarsely dentate with sharp teeth and rounded sinuses, or toward the base lobed to pinnatifid, a pair of linear stipuloid pinnae at the insertion, very thin, pale; the upper lanceolate, less toothed or entire, floccose underneath; inflorescence rather sparse, loosely paniculate; heads 1 cm. long and broad, on peduncles nearly as long; involucre 7 mm. long, short-campanulate from a broad truncate connate base, the scales linear-lanceolate, almost regularly tapering from the base to the acute blackish tip, the midrib darker; at the base of the involucre and upon the peduncles several bracts resembling those of the involucre but smaller; receptacle 2.5 mm. broad, plane, rugose or shallowly foveolate; akenes light brown,

stellate-scurfy, compressed, finely many-nerved, nearly 3 mm. long, oblong-lanceolate; pappus copious, white, fine, minutely scabrous; rays spreading, strongly 5-nerved; disk-corollas 6 mm. long, slender, gradually and slightly broadened upward; base of anthers obtuse, entire; style-branches truncate or sub-rounded.

Turedon, 1891 (1135) near *S. Sepium.*

SENECIO RHIZOMATUS sp. n.

From a horizontal terete rhizome; hispidulous; stem erect, 1–2 dm. high, purple; basal leaves on broad petioles nearly of their own length, the blade 3–6 cm. long, 1–2.5 cm. broad, ovate, cordate or rounded at the base, blunt, irregularly and coarsely sinuate-dentate, probably becoming lobed, thickish, at first erect; the cauline similar but lance-linear, clasping, tapering from the base to an acutish tip, more or less purplish; heads several at the summit, cernuous, about 2 cm. long and 3 cm. broad; involucre distinctly 2-serialled, nearly 2 cm. long, the scales rather lax, purplish with lighter margins, ferruginous-hairy, ovate, acutish, nearly equalling the pappus; rays not apparent; disk-corollas 1 cm. long, the tube proper green, slender, slightly dilated upward, nearly as long as the limb, into which it is abruptly expanded and which is gradually dilated to the summit; anther-bases minutely produced; style-branches abruptly terminating in a discoid dilation; mature akenes not seen.

Near snow-line, Mt. Tunari, 1891 (1050). Apparently the same is (1046) from the same locality. In herb. Kew as *S. croceus* Wedd., apparently a Ms. name and antedated by *S. croceus* (Tratt.) DC.

SENECIO PSIDIIFOLIUS sp. n.

Apparently scandent, glabrous except the puberulent peduncles; branches brownish, finely costate; petioles 1–2 cm. long, stout; blades 5–10 cm. long, 4–6 cm. broad, oval, the base sub-rotund and slightly inequilateral, the apex blunt but minutely cuspidate; entire, finely revolute, thick and rigid, pale green, veins finely reticulate, somewhat prominent beneath, the primaries 8–10 pairs, very crooked and irregular; panicles long, lax, interrupted, the heads 2 cm. broad, in rather dense glomerate or broadly ovoid clusters at the ends of the branchlets; heads on very short subulate or linear-bracted peduncles, 7 mm. long; involucres 4 mm. long, short-campanulate, their basal bracts wanting or rudimentary; scales in a single series, oblong, rigid, obtuse, yellow with brownish middle portion; receptacle plane, sparsely but deeply foveolate; rays few, conspicuous, bright yellow; tubular corollas 5 mm. long, gradually dilated upward, the lobes strongly spreading or recurved; anther-bases strongly mucronate; style-

branches truncate and somewhat enlarged at the tip; akenes short, obovoid, mature ones not seen.

Mapiri, July–Aug., 1892 (1532). Near *S. prunifolius* and *S. Sprucei*.

GYNOXIS MANDONI Sch. Bip. Bull. Soc. Bot. France 12: 86. Name only.

Scandent, the branches weak and slender, finely tomentellate, gray, or on the new growth yellow, angled; petioles 1.5–3 cm. long, stout; blades 6–10 cm. long, 2–4 cm. broad, lanceolate to ovate, base rounded, apex regularly tapering to an acute tip, margin entire or obsoletely toothed, thickish; above bright green, glabrous or sparingly and minutely strigose, underneath tomentellate or glabrate, grayish or yellowish green, the veins slender but prominent, the primaries 12–15 irregular pairs; inflorescence lax, corymbose or broadly paniculate, gray-tomentose, linear-bracted; heads pedunculate, about 1.2 cm. long, campanulate; involucre 8 mm. long, linear-bracted; scales oval-oblong, obtuse; receptacle very small, plane, foveolate; rays narrow, strongly nerved; disk-corollas 7 mm. long, gradually dilated upward; pappus-bristles slightly thickened at the tips.

Espirito Santo, 1891 (1196). The same as Mandon's 84, though less tomentose. Not the same as Linden's 903 and 954, which I take to be *G. pendula*.

GYNOXIS ALTERNIFOLIA Sch. Bip. Linnaea, 34: (1865-66) 531. Name only.

Scandent, the branches stout, crooked, tomentellate, light gray, toward the summit ferruginous; petioles alternate, 2–4 cm. long, stout, fleshy; blades 1–2 dm. long, 3–6 cm. broad, ovate-oblong, base slightly cordate, apex mucronate, margin coarsely and shallowly sinuate, perhaps several mucronate teeth toward the apex; thick and fleshy, above glabrous and very finely reticulate, the midrib slightly impressed, underneath ferruginous or gray tomentose, the veins prominent; inflorescence corymbose, ample, dense, linear-bracted, strongly ferruginous; heads peduncled, 1 cm. long, narrowly campanulate; involucre 6 mm. long, a few linear-subulate bracts at the base similar to those upon the peduncle; scales few, in 2 series, the outer narrower, linear-oblong; receptacle very small, slightly convex, foveolate; rays conspicuous, reflexed, bright yellow, oblong-oval, strongly 5-nerved; disk-corollas 7 mm. long, gradually dilated upward, the lobes nearly 2 mm. long, spreading; anthers early separate, not produced at base; style-branches dilated and hairy at apex; akenes naked, angled, obovoid; pappus white, in a single circle, slightly coherrent at the base.

Vic. Mapiri, 8000 ft. Sept., 1892 (1574). Same as Mandon's 131.

GYNOXIS GLABRIUSCULA sp. n.

Branches blackish or dark brown, at first white-tomentose, but early glabrate, dilated at the nodes; petioles 1.5–3 cm. long, stoutish; blades 4–8 cm. long, 2–4 cm. broad, ovate, the base mostly rounded, tapering regularly to an obtusish or acute point, the margin distantly and minutely toothed; thickish, glabrous both sides, reticulate with inconspicuous veins; inflorescence open, corymbose, white-tomentose, sparingly leafy-bracted; heads short-peduncled, 1.5 cm. long and broad, campanulate; scales 8 mm. long, broadly oval, blunt, purple upward, thick, appressed; receptacle slightly convex, foveolate; rays elongated, oblong, sharply 3-toothed; disk-corollas 1 cm. long, gradually dilated upward, slightly exceeding the pappus, which is in one circle, scabrous, acute; akene 2 mm. long, obovoid, compressed, angled (mature ones not seen); essential organs not mature.

Near snow-line, Mt. Tunari, 1891 (1116). The same as a specimen collected in Bolivia by Bridges.

Werneria villosa A. Gray, Proc. Am. Ac. 5: (1861) 139. Espirito Santo, 1891 (1220). Same collected in Peru by the Wilkes Expl. Exp., but Mandon's 86 and 87 and Lechler's 2111 are apparently distinct.

MUTISIA BIPONTINA Mandon, Bull. Soc. Bot. France, 12: 79. Name only.

A cirrhiferous climber; branches stoutish, coarsely angled, narrowly and thinly winged by the decurrent leaves, yellow-tomentose; leaves sessile, decurrent, terminating in a branched tendril; leaflets 4–7 pairs, imperfectly opposite, their internodes 1.5–2 cm. long; sessile, 4–7 cm. long, 1–3 cm. broad, inequilaterally ovate, the base oblique, rounded or sub-cordate, the apex mucronate, entire, flaccid, above very dark and minutely tomentellate, underneath ferruginous-tomentose, the venation obscure; peduncles very stout, coarsely angled and, like the involucre, ferruginous-tomentose; involucre broadly and irregularly campanulate, the scales spreading or reflexed, about 4 cm. long, linear, tapering regularly from the base to the acute apex; rays deep crimson, glabrous, about 7 or 8 cm. long; disk-corollas 4 cm. long, exceeding the coarse straw-colored pappus about 5 mm.; style-branches long-exserted, slender, slightly clavate.

Espirito Santo, 1891 (1253) = Mandon's no. 6 and Rusby's 1549.

BARNADESIA VENOSA sp. n.

Branches stout, the younger parts puberulent; leaves 8–16 cm. long, 2–4 cm. broad, inequilaterally oblanceolate, tapering into a petiole 5–8 mm. long, with acutely pointed apex, entire, finely reticulate, above dark-green and glabrous, with the veins obscure, underneath very pale or slightly yellowish, the veins prominent, the midrib and 5–8 pairs of strongly ascending and incurved primaries sparingly hairy; branchlets bearing 5–10 loosely corymbed heads, on slender peduncles 1–2 cm. long; involucre campanulate-turbinate; outer scales broadly ovate, thick, with recurved apices, the inner successively longer (becoming 3 cm. long and linear, erect, thick and rigid), sericeous, narrowly scarious-margined and minutely spine-tipped; receptacle slightly concave, with a peripheral circle of large fimbriate-margined foveolae; ray-flowers 8, fertile, the akenes 4 mm. long, densely pilose, dorso-ventrally sigmoid-curved, with very obliquely truncate base, 5-ribbed; the pappus subequal, 1.5 cm. long, 1-serialled, purple, white-plumose, connate at the white base, acute; the corolla bright purple, long-pilose, its tube 2 cm. long, narrowly cylindrical, 5-angled, the filiform lip 1.5 cm. long, entire, the other 2.5 cm. long, 5 mm. broad, oblanceolate, 4-toothed, the teeth 2 mm. long, ovate, acute; the androecium completely tubular, very long-pilose within, equalling the corolla, the anthers 8 mm. long, narrowly linear, not caudate, the appendages 2 mm. long, broader than the anther, obtuse, white with purple midrib, the style reaching to the base of the anther-appendages, cylindrical, of uniform thickness or very slightly thickened upward, glabrous, the branches 1.5 mm. long, 1 mm. broad, flattened, oval, with rounded apex twice the breadth of the style; disk-flower one, neutral, its akene-vestige 2 mm. long and broad, cylindrical, straight with truncate base, densely pilose; pappus bristles equal, 1.25 cm. long, 1-serialled, connate at the base, which is produced downward into a beautifully crenated border, the lower half yellowish white, the upper purple, minutely puberulent, aristiform, rigid, acute, about 25 in number, becoming recurved, the corolla purple, densely pilose, cylindrical, nearly uniform, 2 cm. long, 3 mm. broad, the lobes 2 mm. long, ovate, acute, the base truncate and produced downward into a slight entire acute annulus; style a mere vestige.

Espirito Santo, 1891 (1265). Also collected by Pearce at Muña, 7000–8000 ft.

Plazia daphnoides Wedd. Chlor. And. 1: 12. *pl. 2.* Vic. Cochabamba, 1891 (1147).

SERIS (ONOSERIS) SAGITTATUS sp. n.

Plant 5–10 dm. high or more, the stem and lower leaf-surfaces

densely and closely white-floccose, the peduncles glabrate; petioles 1–2 dm. long, strongly winged, the wings slightly amplexicaul; blades from 6 cm. long by 3 cm. broad to 15 cm. long and broad, triangular-hastate, apex from very acute to obtuse or mucronate, the margin coarsely and irregularly dentate, the sinuses broad, shallow, rounded, the teeth mucronate and salient, upper surface green and glabrous, the veins sparse, whitish, slender, slightly prominent, underneath very prominent, very thin; peduncles sparingly branched, 3–10 dm. long, sharply angled, subulate-bracted, the branches elongated, slender, erect; heads 3–4 cm. long and (as pressed) equally broad, the involucre campanulate, equalling the pappus, the scales imbricated and appressed in many series, the outer successively and regularly shorter, linear, acutish, bright green with 2 darker green stripes, and with white and floccose margins and purplish tips; corollas rose-purple, exceeding the moderately tawny pappus by 1 cm., the pappus at most 1.5 cm. long; akene about 9 mm. long, very strongly and coarsely angled, greenish gray with a rather coarse pubescence.

In dry gravelly or clayey soil, Turedon, vic. Cochabamba, 1891, (1139). Near Pearce's 630, but that has strictly 1-headed peduncles, less floccose and less sagittate leaves.

Perezia pinnatifida (H. & B.) Hook. et Arn. Com. 1: 34. Espirito Santo, 1891 (1217).

Perezia pungens (H. & B.) Less. Linnaea 5: 20 (1830). Var. (?) CERNUA var. nov. Differs from the type in its less broad, cernuous heads, the purple involucral scales broader, with more rounded and more mucronate apex, the midrib less spinescent.

This puzzling form presents some characters strikingly different from those of the type, but I cannot establish specific distinctions. It varies from 1 dm. in height, with solitary heads and basal leaves 8 cm. in length, to 7 dm. in height or more with basal leaves more than 3 dm. in length and 5 to 8 racemosely arranged heads. The leaves are oblanceolate, more or less coarsely sinuately and rather deeply and pungently toothed. The heads are cernuous, 2 cm. long, as broad or broader, with broad, mostly deep purple involucral scales, and a deeply tawny pappus.

Near snow-line, Mt. Tunari, 1891 (1049). The larger form of it from Espirito Santo, 1891 (1218).

PEREZIA FOLIOSA sp. n.

Roots numerous, elongated, fleshy but slender, with few branches; stems several, 3–5 dm. long, weak, ascending, above erect-branched, green or purplish, hispidulous, coarsely angled above; basal leaves numerous, 2 dm. or more in length, oblong to oblanceolate, narrowed into a winged petiole, acute or acutish, the margin thickly beset with unequal small pungent divaricate teeth, bright green, thin, wrinkled, scabrous, especially beneath, the midrib only conspicuous; cauline leaves numerous, ovate, strongly amplexicaul by a broad base, acute, otherwise similar to the basal; heads cymose on few elongated erect branches, 2 cm. long, (exclusive of the corolla) 1.5 cm. broad; scales nearly equalling the pappus, about 10 in number, besides 2 or 3 more leaflike ones at the base, imbricated, rather unequal, appressed, lanceolate, strongly and pungently pointed, green, with a slight keel and scarious margins, except at the summit, where they are spiny-toothed; akene black, obovoid, compressed, the faces lightly keeled, sparsely appressed-sericeous, 4 mm. long by 1.5 mm. broad; pappus copious, coarse, tawny, somewhat unequal, 1.3 cm. long, very minutely roughened; corollas apparently light purple, exceeding the pappus by 6 or 7 mm.; essential organs conspicuous, blue-black.

Turedon, 1891 (1131).

Trixis divaricata (H. B. K.) Spreng. Syst. 3: 501. Mapiri, July–Aug., 1892 (1493) = Rusby's 1699.

TRIXIS AGGREGATA sp. n.

Apparently herbaceous with tufted stems, 5 dm. high or more, the branches erect, stout, originating near the base, simple, green, finely costate, roughish, pubescent, leafy; leaves erect, sessile, 5–7 cm. long, 1–1.5 cm. broad, acute at both ends, with irregular minute sharply salient teeth, bright green, strigose-hairy, very sparsely above, the midrib stout, whitish, the primaries irregularly 10–12 paired, crooked, articulating toward the margin; corymbs nearly 1 dm. broad, the divisions about 4 cm. broad, on peduncles 2 or 3 cm. long and bearing about 7 heads closely aggregated on short peduncles; heads 2 cm. long; involucres about 1 cm. long, campanulate, the principal scales about 8, in a single series, a few shorter ones outside, the longer oblanceolate, acutely pointed, bluntly keeled, puberulent; akenes linear-oblanceolate, 5 mm. long, densely hispid; pappus copious, slightly tawny, about 12 mm. long, minutely toothed; corollas slightly exceeding the pappus.

Vic. Cochabamba, 1891 (1150).

JUNGIA DIVARICATA sp. n.

Fruticose, size unknown, the branches spreading widely, the

branchlets divaricate, rigid, deep purple, puberulent; petioles 1–2 cm. long, stoutish, rigid, terete, purple and puberulent, conspicuously articulated with the stem, the insertion strongly nodose; blades 1.5–4 cm. long and nearly as broad, round-ovate, slightly cordate, with 2 or 3 pairs of triangular acute lobes extending nearly half way to the midrib and irregularly and sharply serrate-dentate, the sinuses of similar form; thick, rigid, strongly reticulate-veiny, above dark green and scabrous, underneath gray-green, pubescent, finely black-glandular; heads articulated to the summit of the branchlets, 1 cm. long and broad; involucre double, the outer reflexed, of several oblong foliaceous scales 3 mm. long by 1 mm. broad, the inner 7 mm. long, campanulate, the scales slightly imbricated, puberulent, appressed, rigid, in a single series, linear-oblong, boat-shaped, acutely pointed; pappus fine, white, one-third longer than the involucre and equally exceeded by the white corollas; akène lance-linear, light brown, densely hispid, 2.5 mm. long; pappus in a single circle, slightly exceeding the tube of the corolla, hispid.

Near snow-line, Mt. Tunari, 1891 (1115). Species near *J. rosea*.

CAMPANULACEAE.

Siphocampylus volubilis (H. B. K.) Don, Gen. Syst. Gard. 3: 703. Vic. Guanai, Dec., 1892 (1593) = 256 and Rusby's 643 and 650; also collected by Pearce at Butero.

SIPHOCAMPYLUS AUREUS sp. n.

Glabrous; stems herbaceous, slender, weak, ascending; petioles .5–1 cm. long, broad, margined, purplish at the base; blades 6–12 cm. long, .5–1.5 cm. broad, lanceolate, with cuneate base and long-acuminate, acute apex, coarsely and irregularly short-serrate, very thin, pale, venation indistinct, the few primaries nearly erect; peduncles 4–6 cm. long, very slender, purple; calyx-tube campanulate, 5 mm. long (in flower), narrowly 10-costate, the lobes about 8 mm. long, linear, tapering from the base to an acute apex; corolla yellow, 5 cm. long or more, infundibular, slightly curved, gradually and regularly ventricose to double the diameter at the base, the upper portion fissured for about 1 cm.; lobes about 7 mm. long, lance-ovate, acute, 2 of them connate for more than half their length; anther-tube 5 mm. long, two anthers slightly tufted, the others nude; mature capsule not seen; when nearly mature tipped with the stout purple style.

Espirito Santo, 1891 (1234). Also collected by Bridges in Bolivia.

SIPHOCAMPYLUS RADIATUS sp. n.

Stem tall, stout, coarsely and irregularly angled, above slightly winged by the decurrent petioles and strongly nodose by the leaf-scars, slightly canescent; floral leaves only seen, sessile and lightly decurrent, 2–3 dm. long, 5–7 cm. wide, irregularly lanceolate, the apex long-tapering, the base less so, irregularly and sharply serrate with rather small cartilaginous, tipped teeth, thinly membranaceous, bright green, smooth both sides, strongly reticulate-veined, the veins impressed above, the midrib very strong and, like the 20–25 irregular pairs of principal veins, whitish and somewhat crooked; unfolding leaves whitish-tomentellate; pedicels solitary in the axils, about equalling their leaves, more or less ascending, stoutish from a much and abruptly contracted base, nearly terete, slightly dilated and compressed at the summit, sparsely puberulent; bud cernuous, becoming erect in anthesis and fruit; calyx-tube in flower nearly hemispherical, 12 mm. broad, in fruit one-half larger, with umbilicate base and contracted margin, strongly 10-ribbed; teeth herbaceous, erect, 2 cm. long, or more, lance-linear from a short broad base, strongly 1-nerved; corolla dull white or yellowish, tomentose within and without, sub-coriaceous, the tube, after drying, about 1 cm. broad, 1.5 cm. long, the limb 2.5 cm. long; seeds blackish, somewhat compressed, trapezoidal, .5 mm. long, white-dotted under a high power.

Vic Cochabamba, 1891 (1106).

Species near *S. giganteus* Britton.

SIPHOCAMPYLUS OBLONGIFOLIUS sp. n.

Glabrous, apparently climbing by tortuous petioles; branches elongated, simple, cylindrical, sharply wrinkled, light brown; petioles 5 mm. long, broad, margined; blade 6–12 cm. long, 2–4 cm. broad, oblong or slightly lance-oblong, with obtuse to sub-rotund base, acutish to acute brown-mucronate apex and a slightly sinuous margin, its teeth reduced to brown mucros similar to that of the apex; dark green, thick, the veins obscure above, underneath the 8–10 pairs of primaries prominent, like the midrib coarse, irregular, whitish; pedicels several in the axils, unequal in developing, those of the preceding season persisting with their calyx-ribs, at length 1.5 cm. long, dilated and angled at the apex and like the calyx papillose; calyx-tube turbinate, in flower 4 mm. broad and high, in fruit twice as large, the teeth 7 or 8 mm. long, subulate, soon spreading or reflexed; corolla deep purple, the tube cylindrical, 2.5 cm. long, 4 mm. broad, the limb 1.5 cm. long. Fruit not seen.

Between Guanai and Tipuani, Apr.–June, 1892 (1461).

Very nearly the same as a specimen collected by Matthews (?), no. 185, Lima, Peru.

Lobelia nana H. B. K. Nov. Gen. 3: 317. *pl. 272.* Below Cochabamba, 1891 (1052) = Rusby's 1075. Vic. Sorata, Nov. 1892. (1622).

VACCINIACEAE.

Psammisia leucostoma Benth.; Meissn. in Mart. Fl. Bras. 7: 127. Mapiri, July–Aug., 1892 (1516).= Spruce's 2465.

Chupalon pubescens (H. B. K.) Kuntze. (See no. 290.) Between Guanai and Tipuani, Apr.–June, 1892 (1383). Leaves somewhat narrower than in no. 290.

ERICACEAE.

Befaria glauca H. et. B. Pl. Equin. 2: 118. *pl. 177.* Espirito Santo, 1891 (1167) = Rusby's 2010 and 2123.

Clethra Brasiliensis Cham. (See 393 and 474.) Between Guanai and Tipuani, Apr.–June, 1892 (1403).

MYRSINEAE.

Myrsine Gardneriana A. DC. Ann. Sci. Nat. (II.) 16: 86. Between Guanai and Tipuani, Apr.–June, 1892 (1422) = Rusby's 866 and 869.

Myrsine Guianensis (Aubl.) R. & S. Syst. Veg. 4: 509. (*Rapanea Guianensis* Aubl. Pl. Gui. 1: 121 [1775]). Between Guanai and Tipuani, Apr.–June, 1892 (1463) = Schomburghk's 695, Spruce's 3918 and Matthews' 1564.

MYRSINE VIRIDIS sp. n.

Glabrous; branchlets purple, slender, terete; petioles .5–1 cm. long, strongly channelled; blades 4–8 cm. long, 1.5–3 cm. wide, oblanceolate to obovate, mostly a little inequilateral, acutish at base and apex, entire, revolute, coriaceous, deep-green, pale beneath, the midrib lightly impressed above, very prominent underneath, the numerous primaries and veins very slender, crooked and inconspicuous; fascicles axillary and supra-axillary, about 8–10-flowered, the flowers very short-pedicelled, the pedicels sharply angled; only withered flowers seen; calyx whitish, 3 mm. broad, lobed two-thirds of the way to the base; corolla purple, coriaceous, lobed nearly to the base, the lobes 2 mm. long, oblong-ovate; style extremely short and stout, stigma large, peltate, lobed and apparently lightly fimbriate; fruit purple, 4 mm. broad.

Mapiri, July–Aug., 1892 (1476) = Fendler's 758 from Venezuela.

PECKIA PSYCHOTRIAEFOLIA sp. n.

Branchlets stout, terete and (like the peduncles, rhachis, pedicels, petioles and lower leaf-surfaces) beset with small purple scurfy glands; petioles about 1 cm. long, stout, subcarinate like the midrib; blades 1.5–2.5 dm. long, 6–9 cm. broad, obovate with cuneate base, the apex very abruptly contracted to a short broad blunt point, entire, membranaceous but rigid, dark-green, glabrous above, the 10–12 pairs of primaries slender, very prominent, abruptly arching upward to connect about 5 mm. from the margin; racemes simple, mostly solitary, erect-spreading, 1–1.5 dm. long, loosely flowered (or becoming loose) the rhachis angled, the subulate purple deciduous bracts nearly as long as the pedicels, which are 1 or 2 mm. long, very stout, horizontal or slightly deflexed; calyx- and corolla-lobes about 1.5 mm. long, oval, broadly imbricated, the corolla greenish and of firmer thicker texture than the persistent white calyx; stamens inserted below the middle of the corolla-lobes, the elliptical anthers nearly as broad as long; fruit (black?) depressed-globose, about 7 mm. broad, minutely tipped with the persistent style.

Between Tipuani and Guanai, Dec., 1892 (1651 in flower) = Rusby's 1218 (in fruit). Species near *P. nitida.*

EBENACEAE.

DIOSPYROS TETRAMERA sp. n.

Glabrous, the branchlets blackish, flexuous, the internodes about 2 cm. long; petioles 3 mm. long, nearly as broad, margined; blades 5–12 cm. long, 2–4 cm. broad, lance-oblong with acutish to sub-rotund base, slightly acuminate but very obtuse apex, and crumpled revolute margin, coriaceous, rigid, pale green, midrib impressed above, prominent and sharp beneath, the veins elevated both sides, reticulate, the primary very numerous; the 4-merous flowers solitary in the axils or several on an apparently axillary branchlet, subsessile, the calyx subtended by about 4 broadly ovate whitish cartilaginous bracts; calyx campanulate, 3 mm. broad, a little longer, very shallowly lobed, cartilaginous: corolla coriaceous, dark purple, in bud lanceolate and acute, in anthesis the campanulate tube 5 mm. longer than the calyx, the mouth 4 mm. broad, the strongly recurved lobes one-half as long the tube, nearly semi-circular; anthers 8, linear, slender, 2 mm. long, scarcely distinguishable from the blackish filaments which are a little more than one-half as long; pistil 7 mm. long, the ovary rudimentary; style stout. Pistillate flowers not seen.

Between Tipuani and Guanai, Dec., 1892 (1681).

APOCYNACEAE.

Thevetia. Species almost certainly undescribed, but must await the collecting of flowers. A little above Cochabamba, 1891 (1088).

Plumiera bracteata A. DC. Prod. 8: 394. Between Tipuani and Guanai, Dec., 1892 (1679).

Forsteronia Sellowii Muell. Arg. (See no. 850.) Between Tipuani and Guanai, Dec., 1892 (1689).

ODONTADENIA BOLIVIANA sp. n.

Glabrous, except the finely tomentellate inflorescence, including calyx and corolla; branchlets stoutish, terete, purple; petioles 1.5–2 cm. long, broad, margined; blades 1.5–2 dm. long, 6–10 cm. broad, oval with a short and broad point, coriaceous, the midrib strongly channelled above, prominent underneath, the 10 or 12 pairs of primaries strongly falcate, especially at the ends, where they connect with those above about 5 mm. from the margin; cymes axillary and terminal, the peduncles about 4 cm. long, stout, sulcate, obsoletely bracted below, several–many-flowered, the pedicels about 1 cm. long, stoutish; calyx about 6 mm. long and broad, coriaceous, divided nearly to the base, the lobes imbricated, rounded, minutely crenate-dentate; corolla yellow (?) about 5 cm. long to the base of the lobes, the tube proper 1–1.5 cm. long, strongly contracted at the summit, the throat 4 cm. long, infundibular, the broad lobes widely spreading, the limb 5 or 6 cm. broad.

Between Tipuani and Guanai, Dec., 1892 (1687).

MANDEVILLA BANGII sp. n.

Glabrous; branches stout for the genus, light reddish-brown, terete, the older portions verrucose, the internodes 5 or 6 cm. long; petioles 1.5–2 cm. long, rather slender; blades .5–1 dm. long, 2.5–5 cm. broad, ovate with cordate base and abruptly acuminate, then tapering, acute apex, membranaceous, pale underneath, the primaries 6–8 pairs, veins inconspicuously reticulate; raceme simple, several–many-flowered; calyx 2 cm. long, parted almost to the base, the lobes linear, tapering regularly from the base to the acute apex; corolla rose-purple, 4 or 5 cm. long, the tubes 2 cm. long, infundibular with narrower cylindrical lower part, the lobes spreading, oval-ovate with rounded apices, 2 cm. broad; anthers 8 mm. long, sessile, inserted at the summit of the contracted basal portion of the tube, adnate below the middle to the stigma, short-acuminate, the apex inflexed, the base short-sagittate, obtuse, or long-sagittate with the lobes adnate; style slender, the stigma 5 mm. long, 3 mm. broad, strongly

5-winged, the wings produced at the base, acutely beaked; disk short, white, fimbriate-divided; glands 5, short, slightly 2-lobed; ovary 3 or 4 mm. long, compressed, ovoid, green. Pedicels in fruit 2–2.5 cm. long, very stout; follicles 2.5–3 dm. long, continuous, terete, reddish, slightly falcate; seeds 1 cm. long, 3 mm. broad when flattened out, lance-oblong, strongly compressed and boat-shaped, keeled upon the concave surface, the keel extending from the apex two-thirds of the way to the base, the coma 2–2.5 cm. long, ample, tawny, shining.

Near snow-line, Mt. Tunari, 1891 (1120).

ASCLEPIADEAE.

Gothofreda Dombeyana (Decne.) Kuntze, Rev. Gen. Pl. 420 (?).

Between Guanai and Tipuani, April–June, 1892 (1395).

Although this plant appears to agree in every respect with the above, it is entirely lacking in the appendages to the pollinia which are characteristic of *Gothofreda*, and it may have to be removed from this genus.

Blepharodon mucronatum (Schlecht.) Decne. in DC. Prod. 8: 603.

Espirito Santo, 1891 (1275).

Ditassa ——? Probably new, but not to be determined without flowers. Between Tipuani and Guanai, Dec., 1892 (1711).

SCHISTOGYNE ATTENUATA sp. n.

Grayish-puberulent or the upper leaf-surfaces sub-glabrous; stems twining, slender, the internodes 1–1.5 dm. long; petioles 1.5–2 cm. long, rather stout; blades 5–8 cm. long, 3–4 cm. broad, ovate, with strongly cordate base, the sinus closed by the overlapping rounded lobes, and with long attenuate apex, thin, veins inconspicuous, or the 5 or 6 primaries slightly conspicuous beneath; peduncles 2.5–3 cm. long, stout, about 5-flowered, the pedicels setaceous-bracted, in flower about 1, in fruit 2 cm. long, more or less recurved; bud 5 mm. long, broadly ovoid, scarcely acuminate at maturity; calyx-tube none, the lobes 5–7 cm. long, lance-linear, tapering to an acute point; corolla-tube saucer-shaped, about as long as the calyx-lobes, about 4 mm. broad, the lobes 8 mm. long, ovate, tapering from base to apex, strongly reflexed; crown adherent to the corolla-tube, of five squamae which are fleshy-thickened, upright, oblong with an indistinct lobe on each side near the apex, and a blunt appendage on the inner face, two-thirds the length of the calyx-lobes; anther-appendages white, membranaceous, oval, extending to the base of the branches of the stigmatic appendage, two-thirds as long as the remainder of the column; callosities linear; stigmatic appendage bright red-purple,

five-cleft, the branches nearly 4 mm. long; fruit (in young state) unarmed, puberulent, lanceolate, tapering.

Espirito Santo, 1891 (1254). Perhaps the same as Mandon's no. 858.

VINCETOXICUM UMBELLATUM sp. n. (Sect. Cynoctonum).

Glabrous, except the minutely puberulent inflorescence; branchlets stoutish, faintly striate, the internodes 2–3 cm. long; petioles 7–10 mm. long, slender; blades 3–5 cm. long, 1.5–2 cm. broad, somewhat inequilateral, obtuse, flaccid, the midrib and 3 or 4 primaries conspicuous, the other veins indistinct, coarsely reticulate; peduncles axillary, solitary, scarcely 1 cm. long; umbels about 2.5 cm. in diameter, rather loose, the pedicels nearly as long as the peduncles, acutely angled; calyx 3 mm. long, divided nearly to the base, the lobes lanceolate, tapering to an acute point; glands oblong, scarcely exceeding the tube; corolla-tube about half the length of the calyx, hemispherical or broader, the lobes 4–5 mm. long, ovate, long-acuminate; crown cup-shaped, 2 mm. long and nearly as broad at the summit, free from the corolla, membranaceous, 5-lobed half-way to the base, each lobe again 2-lobed, each of its halves traversed by a rib with projecting and slightly incurved points; stamen-column shorter than the crown; beak of the stigma entire, twice or thrice the length of the stamen-column, much curved or twisted; fruit not seen.

Vic. Sorata, Nov., 1892 (1620). The same as Mandon's no. (356?) and also collected by Pearce in Bolivia.

The solitary pistil is apparently the result of abortion, as a withered second pistil was found in one flower.

Fischeria Martiana Decne. in DC. Prod, 8: 601 (*Gonolobus M.* Hook. f. Bot. Mag. *pl. 4472*). Between Tipuani and Guanai, Dec., 1892. (1654) = Rusby's 936.

LOGANIACEAE.

BUDDLEIA CANESCENS sp. n.

Densely short yellow-tomentose throughout, except the minutely papillose upper leaf surfaces; branchlets elongated, terete, slender, strongly ascending; petioles 1.5–2 cm. long, stout; blades .5–1.5 dm. long, 2–4 cm. broad, lance-ovate, acute, thickish, entire, the venation inconspicuous, the short, crooked primaries communicating near the margin; peduncles .5–1.5 cm. long, stout, the flowers sessile in dense compound capitate cymes, the bracts oblong, mostly about equalling the 4-merous flowers; calyx 5 mm. long, campanulate, glabrous within, the lobes short and broad,

blunt; corolla deep orange (?), the tube about 6 mm. long, campanulate, the lobes half as long, sub-orbicular; anthers sessile in the sinuses, the stout clavate style slightly exceeding them; ovary globose-pyriform, blackish, slightly tomentose at the summit; fruit not seen.

Near snow-line, Mt. Tunari, 1891 (1117).

Desfontainea parvifolia D. Don, Edin. Phil. Journ. (July–Sept., 1831) 275. Vic. Mapiri, 10,000–12,000 ft., Sept., 1892 (1580) = Rusby's 1950.

GENTIANEAE.

Voyria aphylla (Jacq.) Pers. Syn. 1: 284 (*Gentiana a.* Jacq. Amer. *pl. 60. f. 3*). Mapiri, July–Aug., 1892 (1562) = Rusby's 857.

Lisianthus sp. Espirito Santo, 1891 (1242). This will be treated of by Dr. Gilg in a later publication.

Lisianthus calygonus R. & P. Fl. Per. 2: 14. Between Tipuani and Guanai, Dec., 1892 (1697) = 339.

Gentiana primulaefolia Griseb. Gent. 221. Vic. Cochabamba, 1891 (1153).

GENTIANA COCHABAMBENSIS sp. n.

Stems 2–5 dm. long, decumbent or ascending, branched from the base, the internodes 2–4 cm. long, the inflorescence capitate, congested; lower leaves about 5 cm. long, 1.25 cm. broad, oblong-spatulate, the upper oblong and acute; cymes 3 or 4 cm. broad, scarcely as long, densely many-flowered, the flowers short-pedicelled, 5-merous; calyx 7 mm. long, lobed about half way, the tube turbinate, lightly 10-angled, the lobes triangular-ovate, acute, with herbaceous tips, the sinuses of same form, slightly broader, obtusish; corolla (whitish with blue margins?) naked, 1.5 cm. long, 1 cm. broad, lobed three-fourths of the way, the tube turbinate, the lobes oblong with rounded apex, 5-nerved; stamens and pistil reaching to the middle of the lobes, the anthers bluish, small, the stigmas sessile, very short and broad; fruit not seen.

Espirito Santo, 1891 (1232).

GENTIANA BANGII sp. n.

Stems slender and weak, erect or ascending, 2 or 3 dm. high, purple at the base, sparingly branched, the branches erect or ascending, the peduncles elongated, slender; basal leaves none, the cauline 1.5–2.5 cm. long, .5–1 cm. broad, ovate, acute, strongly 3-nerved; flowers 5-merous; calyx 2 cm. long, lobed two-thirds of the way to the base, the tube campanulate, 10-angled, the lobes linear, tapering to a very acute point, 3-nerved, the nerves strongly

papillose, the sinuses of similar form and size; corolla blue, naked and entire, 4 cm. long, lobed to the middle, the lobes obovate, rounded; stamens and pistil reaching to the middle of the corolla-lobes, the anthers yellow, 4 mm. long, oval, the stigmas nearly circular, 2.5 mm. in diameter.

Turedon, 1891 (1132). Some specimens of another species (perhaps *G. incurva* Hook.) were mixed with this number in distributing and may be recognized by their long (7 cm.) internodes, oblong leaves and triangular calyx-lobes.

GENTIANA MANDONI sp. n.

Erect, slender, 1–3 dm. high, the stems purple at the base, the branches erect and very slender, the internodes about 3 cm. long; basal leaves none, the cauline 1.5–3 cm. long, 3–8 mm. broad, linear-oblong to ovate, acute, sub-3-nerved; pedicels slender, exceedingly variable in length, the longest 2 cm., papillose; flowers 5-merous; calyx papillose, 1–1.25 cm. long, cleft three-fourths of the way to the base, the tube narrowly campanulate, lightly angled, the 3-nerved lobes linear, tapering gradually to a very acute purple point, the sinuses acute; corolla apparently rose-purple, 1.5 to nearly 2 cm. long, about 7 mm. broad at the summit, infundibular-campanulate, the lobes only 5–6 mm. long, obovate, very acute, naked, entire, with darker margins; stamens reaching to the base of the corolla-lobes, in some of the flowers reduced to vestiges 4–5 mm. in length, at the base of the corolla; anthers 2 mm. long; pistil nearly as long as the corolla, the stipe of the ovary as long as the stamens, the style very short, the stigmas strongly flattened, 1.5 mm. long, oval with rounded apex; fruit not seen.

Vic. Cochabamba, 1891 (1143). The same as Mandon's no. 365. Near *G. Pearcei* Phillippi, from Oranco, Chili, but that has rounded petals.

GENTIANA SPECTABILIS sp. n.

Root stout, erect; stems several (and basal leaves numerous) from a many-headed crown, erect or ascending, purple at the base, 2–2.5 dm. high, the internodes 3–6 cm. long; inflorescence virgate-cymose; basal leaves about 1 dm. long, 1 cm. broad, or less, linear-oblanceolate, sub-petioled by the long tapering base, 3-nerved, the apex rounded or blunt; cauline leaves sessile, 2 or 3 cm. long, similar, or lanceolate; flowers loosely cymose, the pedicels 2–5 cm. long, slightly enlarged upward, sharply angled or narrowly winged; flowers 5-merous; calyx 2 cm. long, the tube one-third of its length, turbinate-campanulate, 8-angled, the lobes lanceolate, tapering from the base to an acute apex; the sinuses

obtuse; corolla deep blue, 2–4 cm. long, campanulate, lobed three-fourths of the way to the base, the tube campanulate, the lobes obovate, rounded, entire, naked; stamens two-thirds the length of the pistil, the filaments flattened, the anthers oblong, attached near their summits and accumbent, naked; pistil two-thirds as long as the corolla, the ovary linear-oblong; style very short and broad, the stigmas semi-circular, recurved; fruit not seen.

Vic. Cochabamba, 1891 (1015).

GENTIANA SEMINUDA sp. n.

Primary root short, stout, diffusely branched; stems tufted, ascending, 1–4 cm. long, almost filiform, 1-flowered or rarely branched; basal leaves spatulate, thickish, .5–1 cm. long, 1.5–2.5 mm. broad; cauline leaves usually but one or two pairs, oblong, obtuse, 1-nerved, 3–5 mm. long; flowers 5-merous; calyx 1 cm. long, lobed to a little below the middle, the tube narrowly campanulate, with 10 purple stripes, those continuous into the lobes broad, the alternate ones very narrow, the lobes linear-lanceolate, tapering gradually to an acutish point, the sinuses about twice as broad, obtusish to blunt; corolla bright blue, 1.5 cm. long, 1 cm. broad, lobed to a little below the middle, naked, entire, the tube campanulate, the lobes obovate, acutish; stamens reaching nearly to the middle of the corolla-lobes, the anthers yellow; pistil equalling the stamens, the stigmas very short and broad; fruit not seen.

Espirito Santo, 1891 (1231). The calyx differs slightly from that of Mandon's no. 363, but it may be the same species. It is very near *G. limoselloides* and also *G. primulaefolia* Griseb., but the sepals are too attenuate for either.

GENTIANA VIRGATA sp. n.

Root stout; stems several, stoutish but weak, ascending, 3–5 dm. long, the internodes 4–6 cm. long; branches short, strictly erect, like the pedicels (2 or 3 cm. long), the inflorescence strictly virgate; basal leaves numerous, grass-like, fleshy, 6–10 cm. long, 5–8 mm. broad, obtusish, the cauline similar, 3 or 4 cm. long; flowers 5-merous; calyx 1 cm. long, lobed two-thirds of the way, the obscurely angled tube turbinate, the lobes triangular-lanceolate, tapering regularly from the base to the acute apex, narrower than the acute sinuses; corolla (yellowish with purple margins ?) 2 cm. long, lobed nearly three-fourths of the way to the base, naked, the tube turbinate, the lobes obovate with subrotund apex; stamens a little more than half as long as the corolla, the anthers blackish, 3 mm. long, oblong; pistil a little exceeding the stamens; fruit not seen.

Espirito Santo, 1891 (1230). Also collected in Bolivia by Bridges.

Tetragonanthus gracilis (Griseb.) Kuntze, Rev. Gen. Pl. 431. (*Halenia gracilis* Griseb. Gen. et. Sp. Gent. 327.) Near snow-line, Mt. Tunari, 1892 (1019).

POLEMONIACEAE.

Gilia laciniata R. & P. Fl. Per. 2: 17. *pl. 123. fig. b.* Near snow-line, Mt. Tunari, 1891 (1029).

HYDROPHYLLACEAE.

Phacelia Peruviana (R. & P.) Spreng. (See 169). Near snow-line, Mt. Tunari, 1891 (1040).

BORAGINEAE.

Cordia Gerasacanthus L. Syst. ed. 10, 936. Between Guanai and Tipuani, Apr.–June, 1892 (1347). Espirito Santo, 1891 (1178) = Rusby's 1902.

Cordia hispidissima DC. Prod. 9: 475. Between Guanai and Tipuani, Apr.–June, 1892 (1436) = Rusby's 1901.

Cordia Salzmanni DC. Prod. 9: 494. Between Guanai and Tipuani, Apr.–June, 1892 (1394). Dec. (1443) = Rusby's 2053 and 2054.

CORDIA RUSBYI Britton sp. n.

A stout much-branched scabrous shrub; petioles 3–5 mm. long, stout; blades 2.5–5 cm. long, 1–2.5 cm. broad, angularly ovate with slightly produced base and obtusish apex, irregularly serrate with mostly blunt teeth, thickish and rigid, densely and harshly tomentose both sides, yellowish-gray underneath, the veins deeply impressed above, prominent underneath, the primaries about 5 pairs, strongly ascending, somewhat crooked; peduncles terminal, but some appearing lateral or supra-axillary, 2–3 cm. long, stoutish, the flowers closely capitate, sessile, the heads 1–1.5 cm. broad; calyx rigid (in flower) 5 mm. long, broadly campanulate, lobed nearly half way to the base, the lobes triangular-ovate, acutish; corolla campanulate with somewhat spreading border, about double the length of the calyx, white; stamens a little shorter than the corolla, the anthers broadly oval; style shorter than the stamens, deeply 2-cleft; fruit about 6 mm. long, broadly ovoid, obtuse, not costate, dark brown with whitish summit, two-thirds included in the calyx.

Near snow-line, Mt. Tunari, 1891 (1110). The same collected by myself at Sorata (no. 2456), concerning which Dr. Britton says, "Related to *Varronia crenulata* R. & P., and in part the same as Mandon's no. 527, under *Lantana*."

CORDIA PAUCIFLORA sp. n.

Branchlets, inflorescence and veins underneath pubescent; branchlets elongated, slender, somewhat angled, the internodes very unequal, about 3–5 cm. long; petioles about 1 cm. long, broad, solitary on stout branchlets 2 or 3 mm. long, which bear the peduncles, the latter thus appearing as though axillary and adnate to the base of the petiole; blades .75–1.5 dm. long, 5–7 cm. broad, ovate, the base abruptly contracted and narrowed into the petiole, the apex abruptly short-acuminate and acute, coarsely and obsoletely serrate, the minute teeth salient and acute; membranaceous, thin, deep green, above slightly shining, the venation not prominent, the primaries about 8 or 10 pairs; peduncles 1 or 2 cm. long, bearing a few loose branches, the few flowers sessile near the tips; calyx open-campanulate, 4 mm. long, cleft nearly to the middle, the teeth ovate, acute, with acute sinuses; corolla 5 mm. long, the tube cylindraceous and slightly contracted in its middle part, the limb open-campanulate; stamens about equalling the corolla, the anthers nearly circular in outline; style about half the length of the stamens, entire; fruit not seen.

Espirito Santo, 1891 (1291).

CORDIA BUDDLEOIDES sp. n.

Branches elongated, stoutish, brown, harshly tomentose; petioles broad, varying from scarcely any to nearly 1 cm. in length; blades 7–10 cm. long, 3–5 cm. broad, ovate with very abruptly contracted base and acute apex, obsoletely serrate-dentate, membranaceous but rigid, above scabrous with deeply impressed veins, underneath strigose, with prominent midrib and about 6 pairs of irregular strongly upwardly curved primaries, the veins coarsely reticulate; pseudo-panicles ample, leafy, the spherical heads distantly racemose upon the branches, less than 1 cm. in diameter, very densely flowered; calyx-tube campanulate, 1.5 mm. long, the lobes 3 mm. long, tapering regularly from the base to the acute apex, strongly reflexed; corolla about as long as the calyx, the margin slightly crenulate; stamens included, the anthers subglobular, the cells at the base slightly divergent; ovary pyriform-obovoid, lightly 4-lobed, 1.5 mm. long, the style nearly 2 mm. long, 4-cleft about a third of the way down; fruit not seen.

Mapiri, July–Aug., 1892 (1530). Near *C. patens* H. B. K.

Heliotropium Curassavicum L. Sp. Pl. 130. Near snow-line, Mt. Tunari, 1891 (1039).

CONVOLVULACEAE.

Ipomoea Batatas Poir. in Lam. Encyc. 6: 14. Espirito Santo, 1891 (1290).

Ipomoea macrocalyx (R. & P.) Choisy in DC. Prod. 9: 362 (*Convolvulus m.* R. & P., Fl. Per. 2: 10). Espirito Santo, 1891 (1279).

Ipomoea pentaphylla (L.) Jacq. Coll. 2: 297 (*Convolvulus p.* L. Sp. Pl. ed. 2, 223). Between Guanai and Tipuani, Apr.–June, 1892, (1346).

Ipomoea setifera Poir. in Lam. Encyc. 6: 17? Espirito Santo, 1891 (1278). Differs from the type in being glabrous and minus the awns to the calyx-teeth; but in *I. setifera* the degree of development of the latter is variable.

Ipomoea umbellata L. Syst. ed. 10, 924. Mapiri, July–Aug., 1892 (1482). Determination not free from doubt, as the flowers are wanting.

IPOMOEA MAGNIFOLIA sp. n.

Stems terete, glabrate, the younger portions and inflorescence pubescent; petioles 1–2 dm. long; blades 1 to nearly 2 dm. long, 1–1.5 dm. broad, regularly ovate, the base cordate with rounded lobes and a sinus of 90 degrees or more, the apex very abruptly contracted into a short attenuate point, very thin, above minutely, underneath manifestly strigose, the primaries about 5 pairs, forking at about two-thirds of their length; inflorescence very loosely paniculate, the branches of the panicle elongated, thickish, but weak; pedicels stout, 2 cm. long; calyx 1.5 cm. long, cleft three-fourths of the way to the base, the lobes erect, ovate, acuminate and acute, finely and obscurely nerved, the outer longer; corolla open-campanulate, about 8 cm. long, 5 cm. broad, red-purple with whitish tube and throat; stamens two-thirds the length of the corolla, unequal, the anthers 5 mm. long, 1.5 mm. broad, lance-ovate, sagittate; style equalling the stamens, the stigma sub-globose, lightly 3-lobed; ovary 3-celled; fruit not seen.

Espirito Santo, 1891 (1277). Apparently near *I. pandurata.*

Jacquemontia Blanchetii Moric. Nouv. Pl. Am. *pl. 27.* Between Guanai and Tipuani, Apr.–June, 1891 (1393). Same collected by Dr. Morong in Paraguay.

JACQUEMONTIA ACUMINATA sp. n.

Ferruginous-tomentose throughout, the branches terete, stoutish, the internodes 5–8 cm. long; petioles 3–5 cm. long, blades 8–12 cm. long, 4–6 cm. broad, regularly ovate, the sinus shallow and broad, the apex abruptly attenuate and very acute, the margin ob-

scurely sinuate; thick, densely tomentose or velutinous both sides, venation indistinct, the primaries about 10 pairs; peduncles stout, at length exceeding the leaves; cyme dichotomous, many-flowered, rather dense, linear-bracted, the pedicels about 5 mm. long; calyx campanulate, about 8 mm. long, the lobes rigid, brownish-green with scarious margins, ovate, sharply acuminate, the outer longer; corolla campanulate, 1.5 cm. long, two-thirds as broad at the mouth, red-purple, 5-lobed, the short lobes acute; stamens half the length of the corolla, the filaments at the base dilated and puberulent, the anthers oval; style a little exceeding the stamens, the stigmas turgid or fleshy, broadly ovoid and blunt, nearly 2 mm. long, deeply channeled on the under side, or perhaps reduplicate; fruit not seen.

Espirito Santo, 1891 (1263).

JACQUEMONTIA PEDUNCULATA sp. n.

Scurfy-pubescent throughout, and the younger portions sparsely pilose; root vertical, stout, terete; stems several from a large crown, elongated, slender, ascending or decumbent; petioles .5 to 1 cm. long; blades 1–2 cm. long, .75–1.5 cm. broad, ovate, obtuse, the margin obscurely sinuate, thickish; peduncles solitary at the nodes, appearing as though axillary, one-flowered or at length loosely several-branched, 5 or 6 cm long, subulate-bracted; sepals erect, 5 mm. long in flower, the inner slightly longer, ovate, acuminate and acute; corolla deep blue, nearly 2 cm. long, campanulate with widely spreading border; stamens 5 mm. long, the filaments slightly dilated and pubescent at the base, the anthers large, oval; style a little longer than the stamens, the stigmas ovoid, turgid; capsule 5 mm. long, globose, brown.

Vic. Cochabamba, 1891 (1067). The same as Glaziou's no. 9971.

Convolvulus Bonariensis Cav. Ic. 5: 54. *pl. 480. f. 2.* Vic. Cochabamba, 1891 (1158).

Evolvulus linifolius L. Sp. Pl. ed. 2, 392. Below Cochabamba, 1891 (1006).

Cuscuta grandiflora H. B. K. Nov. Gen. 3: 123. *pl. 213.* Vic. Sorata, May, 1892 (1304) = Rusby's 2006.

CUSCUTA FRAGRANS sp. n.

Glabrous; inflorescence dense, the flowers sessile; calyx 7 mm. broad when expanded, 5-parted two-thirds of the way to the base, the lobes somewhat unequal, rhomboidally-ovate, blunt; disk deep orange or scarlet, annular, thickish, sinuately lobed, prominent; corolla-tube 4 mm. long, urceolate, the lobes ovate, obtuse, 3 mm. long, strongly reflexed; anthers reaching to the middle of

the corolla-lobes; scales broad, fimbriate, reaching nearly to the base of the anthers; ovary large; styles stout; stigmas large, white, capitate.

Vic. Sorata, May, 1892 (1303). The flowers are very fragrant. It is very near *C. odorata* R. & P., but does not agree with either the figure or the description.

SOLANACEAE.

Solanum argenteum Decne. in Poir. Encyc. Supp. 3: 755? Between Tipuani and Guanai, Dec., 1894 (1699).

Solanum asarifolium Kunth et Bouché, Ind. Sem. Hort. Ber. (1845) 10. Espirito Santo, 1891 (1235).

Solanum Gayanum (Remy) Phil. Cat. Pl. Vasc. Chil. 228. Vic. Cochabamba, 1891 (1151).

Solanum mammosum L. Sp. Pl. 187. Between Tipuani and Guanai, Dec., 1892 (1735).

Solanum nigrum L. (See 539 and 727). Between Guanai and Tipuani, Apr.–June, 1892 (1462).

Solanum nutans R. & P. Fl. Per. 2: *pl. 166.* Between Tipuani and Guanai, Dec., 1892 (1740) = Linden's 218.

Solanum polytrichum Moric. Nouv. Amer. 32. *pl. 22.* Between Guanai and Tipuani, Apr.–June, 1892 (1374) = Salzmann, "Bahia, in collibus," not Sellow's 363.

Solanum Schlechtendalianum Walp. Rep. 3: 61. Mapiri, July–Aug., 1892 (1566). In the many representatives of this species in the Kew Herbarium, the flowers are uniformly smaller and the indumentum less aureous than in Mr. Bang's specimen, but I can hardly regard the latter as distinct. It is the same as Spruce's no. 791 and near Schomburghk's 859, which has a truncate calyx and different anthers.

Solanum styracioides Rusby. (See No. 522.) Between Tipuani and Guanai, Dec., 1892 (1662).

Solanum tuberosum L. Sp. Pl. 185. Vic. Cochabamba, 1891 (1100 and 1101) = Pentland's Titicaca specimen.

Solanum validum Rusby (see no. 972). Vic. Cochabamba, 1891 (1096).

Solanum Wrightii Benth. Pl. Hartw. 243. Vic. Guanai, July, 1892 (1608).

SOLANUM AUREIFOLIUM sp. n.

Glabrous, except the puberulent flowers, shrubby, much and widely branched, the branches light brown, striate, the internodes 2–2.5 cm. long; petioles 1–2 cm. long, broad but weak; blades .75–1.5 dm. long, 3–5 cm. broad, lance-oblong to oblong-ovate, the base blunt, the apex abruptly contracted into a tapering and acute point, thin, drying yellowish-green, the primaries 5–7 pairs, slender, irregular and crooked, the venation very fine and obscure; peduncles 2–3 cm. long, angled, the cyme racemiform, very loose, twisted, the pedicels 1.5 cm. long, faintly striate, at the apex dilated and angular; calyx cup-shaped to saucer-shaped, lobed about half-way to the base, the lobes triangular, acuminate and acute, with broad rounded sinuses; corolla pubescent, 1 cm. long, divided nearly to the base, the lobes oblong-ovate, obtuse, white, translucent and conspicuously reticulate-veined; anthers 7 mm. long, lanceolate, slightly whitish-thickened at the summit, where the small pores look directly upward and are continuous with lateral sutures; style stout, slightly exceeding the anthers, the stigma very small; fruit a little more than 1 cm. broad, red when immature, deep red-purple at maturity.

"Near snow-line, Mt. Tunari" (?), 1891 (1119).

SOLANUM CLAVATUM sp. n.

Glabrous; a much-branched shrub, the branchlets crowded, irregular, short and stout, very leafy, the internodes .5–1 cm. long; leaves 6–15 cm. long, 1–4 cm. broad, lance-oblong, the base tapering into a winged petiole about 1 cm. long, the apex obtusish; the margin entire but irregular, thick and rigid, pale beneath, where the midrib is very stout and prominent, the primaries 10 or 12 pairs, the reticulation indistinct; peduncles 2–5 cm. long, slightly thickened upward; cymes 5 or 6 cm. broad, mostly 10–20-flowered, the pedicels about 2 cm. long, clavate and quadrangular at the summit; calyx-tube proper cupulate, 3 mm. long, 5 mm. broad, the teeth mostly a little longer, narrowly triangular-acuminate, the sinuses broad and rounded; corolla white, finely spotted inside, thickish, 1.5 cm. broad; anthers 5 mm. long, nearly 2 mm. broad, lance ovate, obtuse, straight, the pores directed about equally upward, inward and laterally; style exceeding the anthers by one-half their length; fruit dull, about 1 cm. in diameter.

Near snow-line, Mt. Tunari, 1891 (1118. It appears that some specimens of the next may have been accidentally mixed with this number in distributing). The same species collected on Mt. Chimborazo. The specimens in Herb. Kew bear the number 33, but the name of the collector does not appear.

SOLANUM HIBISCIFOLIUM sp. n.

Yellowish-gray throughout, with dense stellate-scurfy tomentum; branches stout, terete; petioles 4–8 cm. long, stout; blades .75–1 dm. long, .5–1 dm. broad, oval-ovate, the base more or less cordate, the apex barely pointed, acutish, the margin entire but irregularly waving; thickish but flaccid, venation inconspicuous above, the midrib and 5 or 6 pairs of primaries prominent and stout underneath, their secondaries meeting about midway at a broad angle; peduncles stout, 6–8 cm. long, the cymes 6–10 cm. broad, rather densely flowered; pedicels stoutish, 1.5–2 cm. long, erect; calyx about 1 cm. long, the lobes thickish, erect, broadly ovate, acute, with acute sinuses; corolla white, one-fourth or one-third longer than the calyx, thickish; anthers 4 mm. long, oblong, blunt, the cells a little produced at the base, the pores looking directly inward; style 1 mm. longer than the anthers; fruit 1 cm. broad, slightly elongated, sparsely short-stellate.

Vic. Cochabamba, 1891 (1141). Near *S. verbascifolium*.

SOLANUM LINDENII sp. n.

Glabrous, or the twigs puberulent; shrubby, the branchlets erect, stoutish, flexuous, coarsely and bluntly angular, the internodes 2.5–5 cm. long; petioles 1–1.5 cm. long, broad; blades .75–2 dm. long, 4–7 cm. broad, oval, obtuse at both ends, entire, revolute, coriaceous, the venation obscure except the midrib and 7–10 pairs of primaries, the secondaries connecting with the primaries and with the midrib; peduncles 1.5–2 cm. long, the cymes few-flowered, loose, the pedicels 1–1.5 cm. long, slender; calyx-tube hemispherical, 4 or 5 mm. broad, the lobes less than half as long, very broad, acute, with acute sinuses; corolla white, rigid, 7 or 8 mm. long, the lobes oval-ovate, very acute; anthers 5 mm. long, straight, oblong, blunt at both ends, the pores looking inward rather more than upward, prolonged downward into sutures; mature fruit not seen.

Mapiri, July–Aug., 1892 (1526). The same as Linden's 1624 from New Granada and almost Fendler's 978 from Venezuela.

SOLANUM PHYSALIFOLIUM sp. n.

Glandular-pubescent, herbaceous, widely branching, the branches coarsely and sharply angled, the internodes irregular and very unequal; petioles .5–1.5 cm. long, slender and weak; blades 2–4 cm. long, 1–2.5 cm. broad, rhomboidally ovate, acute, coarsely and rather indistinctly sinuate-lobed, thin, flaccid, the venation inconspicuous, the reddish primaries about 5 irregular pairs; peduncles about 1 cm. long, mostly 3–5-flowered, the pedicels 1–1.5 cm. long, weak; flowers white, only 5 mm. long; anthers 2 mm. long, oval, the pores looking upward and inward;

fruiting calyx spreading, 1 cm. broad, the lobes oval, obtuse; fruit green, shining, 1 cm. in diameter, the epicarp very thin.

Vic. Cochabamba, 1891 (1159). Near *S. phyllanthum* Cav.

SOLANUM SYMMETRICUM sp. n.

Glabrous; branchlets erect, rather slender, very flexuous, blackish, the internodes 2–2.5 cm. long; petioles 1 cm. long; blades about 1 dm. long and 5 cm. broad, oval, the base shortly acuminate, apex obtuse; entire, thin but rigid, the midrib and about 7 pairs of primaries prominent beneath, the reticulation fine, indistinct; peduncles mostly solitary at the nodes, 1 cm. long, slender, divergent, the rhachis spiral or cochleate, so as to make the many-flowered cyme sub-spherical; cyme 2.5–3 cm. in diameter, the pedicels slender, about 7 mm. long; calyx open-campanulate, 2.5–3 mm. long and broad, divided nearly midway, the lobes triangular and acutish, the sinuses nearly of the same form; corolla white (with violet center?), rotate, strongly reflexed, 5 or 6 mm. long, deeply lobed, the lobes tapering-ovate; anthers 3 mm. long, straight, oblong and somewhat narrowed toward the base, the pores facing inward, upward and laterally; style a little exceeding the stamens, stout, clavate, the stigma large; fruit not seen.

Mapiri, July–Aug., 1892 (1478).

SOLANUM VELUTISSIMUM sp. n.

Shrubby, unarmed, the branchlets short, stout, divergent, terete, blackish, the leaves crowded at their summits, the younger parts, like the inflorescence, petioles and lower leaf-surfaces, densely white stellate-scurfy; petioles .5–1 cm. long, margined; blades 4–10 cm. long, 2–5 cm. broad, oval, acute, thick, above of a bright (slightly yellowish) green and densely velutinous; peduncles 3–4 cm. long, stout, erect, the cyme 6–8 cm. broad; calyx broadly campanulate to saucer-shaped, about 7 mm. broad; divided nearly midway, the lobes triangular-ovate, acute, 3 mm. broad, sinuses acute; corolla (light-blue?) stellate-scurfy without, divided nearly to the base, the lobes nearly 1 cm. long, ovate; anthers 3 mm. long, oblong, lightly curved, the pores looking inward and a little upward; style stout, tapering, stellate-scurfy; immature fruit lightly stellate-scurfy.

Vic. Sorata, 8,000 ft., Nov. 1892 (1627). Near Mandon's 424, but the calyx-teeth are different.

Solanum sp. almost certainly undescribed, but must await flowers.

Near *S. Swartziana*, but the calyx and fruit are different. Vic. Sorata, 1892 (1630). Nearly the same as Rusby's 777.

CYPHOMANDRA UNILOBA sp. n.

Glabrous, except the under leaf-surfaces; branches elongated, weak and apparently reclining; petioles 2.5–5 cm. long, slender; blades 1–2 dm. long, .5–1 dm. broad, ovate, the base inequilateral and somewhat cordate, the apex normally acute, or in some cases shortly pointed, the margin obscurely and coarsely sinuate-lobed, many of the leaves with one large sinus hollowed out near the base upon the larger side, thin, sparsely and very minutely strigose on the lower surface; peduncles 3–5 cm. long, the cyme dichotomous, its branches elongated and racemiform; pedicels 1–1.5 cm. long, angled, dilated at the summit; calyx open-campanulate, 5 mm. long and a little broader, the margin sinuately lobed, rigid; corolla 8–10 mm. or occasionally 15 mm. long, deeply cleft, thickish, the lobes ovate, acuminate; anthers 6 mm. long, ovate, the dorsum lightly outwardly arched, the turgid brown connective entirely concealing the thecae at the back, the pores very small, looking inward, laterally, and a little upward, continuous with fully developed sutures; style very stout, angled, about as long as the anthers, the stigma large, its margin lightly sinuately lobed; fruit not seen.

Mapiri, July–Aug., 1892 (1535).

Bassovia solanacea Benth. & Hook. f. Gen. Pl. 2: 891. Espirito Santo, 1891 (1210). The strigose form.

BASSOVIA INAEQUILATERA sp. n.

Herbaceous; the branches, inflorescence and veins underneath cinereous, the leaf-surfaces sparsely strigose; branches slender, flexuous, angled, the internodes 2.5–4 cm. long; petioles 1 cm. long, broad; blades 1–2 dm. long, 0.5–1 dm. broad, oval-obovate, very inequilateral, the base acuminate, the apex abruptly very short-pointed and acute; entire, very thin, dark-green, underneath paler, the primaries 12–15 pairs, strongly falcate-ascending, reticulation very coarse and inconspicuous; cymes sessile, loosely few-flowered, the pedicels unequal, the longest 1 cm. long, slightly dilated upward; calyx 2 mm. broad, slightly longer, 10-toothed, the teeth very small; corolla-lobes 4.5 mm. long; style 4 mm. long; fruit not seen.

Between Tipuani and Guanai, Dec. 1892 (1708).

The following specimens, seen in Herb. Kew. under *Solanum*, require careful comparison with this plant: Spruce's nos. 4182 and 4849 from Tarapota (but not the finely lepidote specimen from the same place); R. Tate's 262, labeled *Solanum foetidum*, and Gaudot's New Grenada specimen, labeled *S. radiatum*. It is the same as Rusby's 765 from Bolivia.

Capsicum baccatum L. Mant. 116. Turedon, 1891 (1126) (Cult.).

Capsicum frutescens L. Sp. Pl. 189. Espirito Santo, 1891 (1185). Mapiri, July–Aug., 1892 (1474) (Cult.).

POECILOCHROMA ALBESCENS Britton, sp. n.

A low strongly branching shrub, the branches ascending, scurfy, above pubescent; petioles 2 or 3 mm. long, whitish, blades extremely variable in size, in some specimens only .5–1 cm. in length, in others 2 or 3 cm. long, .75–1.5 cm. broad, oval-ovate, slightly inequilateral, obtuse, revolute, thickish, rigid, above glabrous, pale, the veins impressed, underneath very pale or whitish, papillose, the veins prominent; cymes lateral, loosely few- (mostly 3- or 4-) flowered, slenderly peduncled, the pedicles filiform, 1 or 2 cm. long; flowers white, their size proportionately greater in the larger-leaved form, 1.5–2.5 cm. long; calyx 3 mm. long and broad, cleft half-way to the base, the tube broadly campanulate, the lobes triangular-ovate, obtuse; corolla broadly campanulate, the lobes about 7 mm. long and broad, triangular-ovate; filaments inserted into the base, 2 mm. long, the anthers distinct, 4 mm. long, lance-ovate, truncate; style filiform, considerably exceeding the stamens, the stigma inconspicuous.

Vic. Mapiri, 8,000 ft., Sept. 1892 (1575), the form with smaller leaves and flowers. The larger form is Rusby's 2564, from which the above measurements of the dissection are taken.

Salpichroa glandulosa (Hook.) Miers, in Hook. Lond. Jour. Bot. 4: (1845) 325. (*Atropa g.* Hook. Bot. Misc. 2: 230.—Hook. Ic. *pl. 106*). Near snow-line, Mt. Tunari, 1891 (1048).

LYCIUM PAUCIFOLIUM sp. n.

A much branched, spiny shrub, the branchlets much elongated, slender, flexuous, horizontal or lightly ascending, whitish, glabrous, the spines divaricate, .5–1.5 cm. long, slender, terete, very pungent; leaves .5–1 cm. long, 2 or 3 mm. broad, oblong-obovate, obtuse, with a tapering petiole-like base half as long as the laminate portion, entire, thickish, very minutely scabrous, pale, the veins indistinct; pedicels unequal, the longest nearly 1 cm. long, slender, thickened upward; bud obovoid, obtuse, 4 mm. long; calyx campanulate, striate, 4 mm. long, lobed a fourth or a third of the way to the base, the lobes triangular, acute, the sinuses of the same form; corolla-tube infundibular, twice the length of the calyx, the lobes about 3 mm. long, obovate, obtuse, strongly reflexed; stamens a little exceeding the corolla-lobes; fruit elongated-globose, 5 or 6 mm. long.

Vic. Cochabamba, 1891 (1098). Very nearly, if not, identical with a specimen collected by Jameson in the Argentine.

MARKEA VERRUCOSA sp. n.

Branchlets very stout, densely verrucose with intermediate stellate pubescence; leaves sub-ternately arranged; petioles 5 mm. long, very stout, leaving a nearly circular whitish concave scar 5–7 mm. broad; blades 1.5–2.5 dm. long, .7–1 dm. broad, oval, the base acute, the apex abruptly contracted into a short broad acute point, coriaceous, above so densely and shortly velutinous as to appear glabrous, the veins impressed, underneath densely yellowish short-stellate; peduncle and rhachis together 6 dm. long, or more, verrucose, distantly branched; flowers not seen; fruiting calyx-tube turbinate, 1.5 cm. long, 1 cm. broad, the limb divided nearly to the base, the lobes 4 cm. long, lanceolate, acuminate and acute, coriaceous; apparently purple, reticulate-veined, glabrous; fruit 2 cm. or more in diameter, the pericarp wanting, the very numerous seeds nearly 3 mm. long, ovate, obtusely angled, the base obliquely truncate.

Espirito Santo, 1891 (1294).

Unique in the genus in its very peculiar indumentum.

Cestrum coriaceum Miers in Hook. Lond. Journ. Bot. 5: (1846) 160. Guanai, Dec., 1892 (1634. A few specimens of the fruit perhaps distributed separately as 1414.) Apparently an extreme form of this variable species.

Cestrum strigillatum R. & P. Fl. Per. 2: 29. *pl. 156.* Espirito Santo, 1891 (1189).

CESTRUM FLORIBUNDUM Britton, sp. n.

Glabrous, except for the very slight and sparse puberulence of the inflorescence; branches elongated, coarsely angled at the summit, the internodes about 3 cm. long; petioles 1 cm. long, weak; blades .5–1.5 dm. long, 3–7 cm. broad, regularly ovate with rounded base and acute apex, thin but somewhat rigid, the primaries 7–9 pairs, strongly falcate-ascending, the reticulation very coarse and faint; panicle ample, rather lax, leafy, the branches horizontal; pedicels very slender, 2 or 3 mm. long; calyx open-campanulate, 3 mm. long, lobed to a variable depth, mostly one-fourth to one-third of the way, the lobes broadly ovate, whitish-ciliate-margined; corolla-tube nearly 2 cm. long, 1.5 mm. broad, at the summit abruptly dilated to 2.5 mm., the lobes 6 mm. long, oblong, acute, strongly reflexed, whitish with broad green middle portion; stamens and style about equalling the corolla-tube; fruit not seen.

Espirito Santo, 1891 (1200) and between Guanai and Tipuani, Apr.–June, 1892 (1470). The same Rusby's 818.

Sessea vestita (Hook.) Miers in Hook. Lond. Journ. Bot. 5 : (1846) 155. (*Cestrum v.* Hook. Ic. *pl. 381*). Espirito Santo, 1891 (1164).

Nicotiana glauca Grah. Bot. Mag. *pl. 2837*. Espirito Santo, 1891 (1182).

Nicotiana tomentosa R. & P. Fl. Per. 2: 16. *pl. 129. fig. a.* Vic. Sorata, Nov. 1892 (1625)=Rusby's 2533.

Browallia viscosa H.B.K. Nov. Gen. 2: 373. Mapiri, July–Aug., 1892 (1533.)

Brunfelsia latifolia (Pohl) Benth. in DC. Prod. 10 : 199. (*Franciscea l.* Pohl, Pl. Bras. Ic. 3: *pl. 2.*) Between Guanai and Tipuani, Apr.–June, 1891 (1398)=Rusby's 621.

SCROPHULARINEAE.

Fagelia deflexa (R. & P.) Kuntze, Rev. Gen. Pl. 459 (*Calceolaria d.* R. & P. Fl. Per. 1: 18. *pl. 30.* Near snow-line, Mt. Tunari, 1891 (1038)=Mandon's 455 at Herb. Kew, except for a fragment of some other species.

Fagelia chelidonioides (H.B.K.) Kuntze, (see 720). Near snow-line, Mt. Tunari, 1891 (1018).

FAGELIA TRILOBATA (Hemsl.) (*Calceolaria t.* Hemsl. Biol. Cent. Am 2 : 439). Espirito Santo, 1891 (1226).

Mimulus glabratus H.B.K., Nov. Gen. 2 : 370. A little below Cochabamba, 1891 (1014).

Stemodia pusilla Benth. Bot. Sulph. 144. Between Guanai and Tipuani, Apr.–June, 1892 (1388).

Stemodia pauciflora Ait. Hort. Kew. ed. 2, 4 : 52. Between Guanai and Tipuani, Apr.–June, 1892 (1387) = Mandon's 467.

COLUMELLIACEAE.

COLLUMELLIA SERRATA sp. n.

Glabrous; branchlets numerous, 1.5–2 dm. long, slender, tough, erect or ascending, light gray-brown, sharply but irregularly angled, enlarged at the nodes, which are about 1 cm. apart; petioles about 5 mm. long, broad, margined, sharply carinate, the keel extending along the midrib; blades 3–6 cm. long, 1–2 cm. broad, oblanceolate, very inequilateral, the base cuneate, the apex rounded; coarsely serrate, the teeth erect with enlarged purple tips, thick, the veins strongly impressed above, finely reticulate;

cymes terminal, few-flowered, the purple-angled pedicels about 1 cm. long; calyx-tube 3 mm. long, turbinate, purple, angled, the reflexed foliaceous lobes nearly as long as the tube, oval to obvate with rounded apex, 3-nerved, the nerves purple; corolla (yellow) about 2 cm. broad, lobed more than two-thirds of the way to the base, the lobes sub-orbicular, with entire crisped margin; filaments inserted at the base of the tube, very stout, 4 mm. long; the anther large, curved into a globose mass 3 mm. in diameter; disk greenish, of two very broad thick fleshy glands interposed between the stamens, adnate to the bases of the ovary and corolla; ovary fleshy, compressed, 4 mm. broad, the top deeply grooved along the long axis; style brown, about as long as the filaments, very stout, much enlarged at the summit, the stigma nearly 3 mm. broad, peltate, thick, fleshy, white, irregularly lobed.

Espirito Santo, 1891 (1172).

GESNERACEAE.

GLOXINIA REFLEXA sp. n.

Younger portions long-pilose and glandular; stems erect or ascending, coarsely angled, weak, simple, the internodes 4 or 5 cm. long; petioles 2.5–5 cm. long, broad; blades 6–10 cm. long, 4–8 cm. broad, ovate, very inequilateral and the slightly cordate base very oblique, the apex short, acuminate and acute; coarsely crenate-serrate, very thin, bright green, sparsely and minutely hispid-strigose on both sides; peduncles axillary, about 1 cm. long, 5–15-flowered, the pedicels about as long; calyx-tube 7 or 8 mm. long, 2 mm. broad, cylindraceous-infundibular, the reflexed, herbaceous lobes about of equal length, oblanceolate with rounded apex; corolla (purple-white?) pubescent, 2.5 cm. long and broad (as pressed), open-campanulate with rounded ventricose base, and lightly lobed sub-equal sparsely fimbriate margin; stamens shorter than the corolla, the filaments capillary.

Vic. Mapiri, Jan., 1893 (1745). It has no near relative, and its reference to this genus is somewhat doubtful.

ACHIMENES ALBESCENS sp. n.

Finely short-strigose; rhizome oblique; stems ascending, weak, the nodes few and distant; leaves .75–1.5 dm. long, 2–4 cm. broad, inequilateral, oblong, the base tapering gradually into a short petiole, the apex acuminate and acute; entire, very short strigose both sides, above whitish and papillose, underneath purplish; peduncles axillary and terminal, 1-flowered, 3–6 cm. long, very slender; calyx 1 cm. long, lobed two-thirds of the way, the tube broadly turbinate, lobes narrowly lance-linear, the two upper a little shorter and broader, sinuses broad and rounded; corolla purplish-white, pubescent, 1.5 cm. long and half as broad,

the base strongly declined, sub-saccate on the upper side, the body swollen on the lower side, the mouth sub-equal, the lobes 3 mm. long, erect, spreading; ovary short and broad, style stout, pubescent; stigma ovoid, the apex concave; disk annular, short, sinuate.

Espirito Santo, 1891 (1211).

ACHIMENES RUSBYI Britton, sp. n.

Strigose-tomentose and the younger parts long-pilose; a portion of the nearly horizontal rhizome densely imbricated with fleshy scales each 1 cm. long and two-thirds as broad, reddish brown with whitish margins; stem erect, simple, 3–6 dm. or more high, reddish, the internodes .7–1 dm. long, the leaves ternate or opposite below; petioles 1–2 cm. long, slender; blades 5–8 cm. long, 2.5–4 cm. broad, ovate, the base obtuse, the apex tapering and acute, coarsely serrate, the teeth acute, purplish underneath, the venation obscure; flowers apparently only one to several, terminal, and occasionally in the upper axils; pedicels 2 or 3 cm. long, ascending; calyx nearly 2 cm. long, the campanulate tube one-third of its length, the lobes linear or almost setaceous, the sinuses broad and rounded; corolla deep maroon-purple, 4 or 5 cm. long, nearly straight, the base very oblique; narrow basal portion of tube 1 cm. long, 5 mm. broad (as pressed), gradually dilated into the ventricose body, which is 1.25 cm. broad; mouth 2 cm. broad, lightly oblique, the lobes reflexed, beautifully margined and spotted with deep indigo-purple; stamens barely exserted.

Between Tipuani and Guanai, Dec., 1892 (1721) = Rusby's 1102.

ACHIMENES FLACCIDA sp. n.

Rhizome slender; hirsute; stems erect or ascending, slender and weak, sparingly branched or simple, green or purplish below, long-pilose, the internodes about 1 dm. long; petioles only 2–3 mm. long, very broad; blades 6–9 cm. long, 3–4 cm. broad, ovate, short-acuminate and acute, minutely serrate and strongly ciliate, thin and flaccid, pale, strigose underneath and very sparsely so above; peduncles 1-flowered, solitary in the upper axils, and terminal, 2–4 cm. long; calyx 1 cm. long, lobed to or a little below the middle, the tube turbinate, purple (like the peduncle), densely strigose, the lobes green, subequal, lance-ovate, long-acuminate and acute; corolla deep rose-purple, tomentose, 3 cm. long when fully developed, 1.5 cm. broad, as pressed, the base oblique, the narrow basal portion scarcely any, body ventricose, mouth subequal and contracted, lobes small, erect-spreading; stamens and style about as long as the corolla; disk annular, deeply sinuately lobed; style stout, pubescent, stigma ovoid.

Espirito Santo, 1891 (1213).

SEEMANNIA CUNEATA sp. n.

Closely short-strigose and purple throughout; rhizome oblique, short, stoutish, sparsely hairy, bearing short whitish fleshy imbricated scales; stems .5–1 m. or more high, erect, stoutish, simple, the internodes of very irregular length, the upper much elongated; leaves ternate, ovate, 5–8 cm. long, 2–3 cm. broad, the tapering cuneate base passing into a petiole 1–2 cm. long, the apex acute; entire, thickish and sub-rigid, thickly and closely strigose; peduncles stout, erect, about 2 cm. long; calyx-tube turbinate, 4 mm. long, the lobes sub-equal, 6 mm. long, narrowly lance-linear, tapering from the base to an acute point, erect, rigid; corolla scarlet, tomentose, nearly 1.5 cm. long, half as broad, the base oblique, declined and gibbous on the upper side, the body cylindraceous, the mouth slightly contracted, the lobes very short, erect-spreading; stamens nearly equalling the corolla, strongly gibbous at the base; style stoutish, flattened, puberulent, the stigma 2-lamellate, the lobes broadly ovate, obtuse; ovary sub-truncate; disk annular, sinuately lobed; fruit oval-ovoid, 8–10 mm. long.

Espirito Santo, 1891 (1212). The same as Rusby's 1100 but not 1101. It differs from *S. ternifolia* Regel in the cuneate petioled leaves, longer and more rigid peduncles and smaller and narrower flowers. A different species, with leaves rounded at the base and scarcely petioled, was mixed with this in distribution.

Koellikeria argyrostigma (Hook.) Regel. (See no. 275.) Between Tipuani and Guanai, Dec., 1892 (1720).

DIASTEMA LATIFLORA sp. n.

Herbaceous, green or purple, very sparsely short-pilose, flowering when 2 or 3 cm. high, at length 3 dm. high or more, simple or sparingly branched, erect; leaves varying proportionately with the size of the plant, at length 1.5 dm. long and .75 to 1 dm. broad, the broad margined petioles one-third of the length; ovate, the base very abruptly contracted, the apex obtusish, coarsely, irregularly and deeply crenate-serrate, the teeth obtuse, longer than broad, very thin, the venation coarse and broad; pedicels loosely cymose-paniculate, 2 cm. or more long, slender, erect; calyx 7 or 8 cm. long, lobed two-thirds of the way, the tube in fundibular-campanulate, the lobes obovate with rounded apex and acute sinuses, strongly herbaceous, in flower spreading or reflexed, in fruit again erect; corolla (rose-purple?) sparsely hairy, 1.5 cm. long, 1 cm. across the oblique mouth, conspicuously curved, campanulate, lobed nearly to the middle; filaments capillary, purple, nearly equalling the corolla; fruit not seen.

Between Tipuani and Guanai, Dec., 1892 (1728). The same as a specimen collected in Ecuador by Dr. Sinclair, and one of

those collected in Bolivia by Pearce. Different from Mathews' and Spruce's. Species near *D. urticaefolia*.

ISOLOMA SPRUCEI Britton, sp. n.

Strigose; stem rooting at the base, erect or ascending, 3–6 cm. high, branched only at the inflorescence, quadrangular, densely strigose-tomentose, the internodes 5 or 6 cm. long; petioles 2 or 3 cm. long; blades 1–1.5 dm. long, 4–6 cm. broad, oblong, slightly inequilateral, closely serrate, the teeth mostly acute, above bright green and short-strigose, underneath bright purple and sparsely pubescent, the veins densely strigose; peduncles in the upper axils, 2 or 3 cm. long, stoutish, umbellately 5–8-branched, the branches at length nearly as long as the peduncles, 1-flowered, the bracts in the form of small leaves; calyx densely tomentose, 7 or 8 mm. broad, the tube very short, saucer-shaped, the lobes short, broadly ovate to semi-circular, slightly pointed, soon re flexed; corolla tomentose, deep purple, 1.25–1.5 cm. long, the base very oblique, the tube campanulate, ventricose, curved, 7 mm. broad, the somewhat oblique mouth but little broader; fruit 5 mm. broad.

Vic. Mapiri, Aug., 1892 (1541). The same as Rusby's no. 2151. Description taken from Mr. Bang's specimens.

ISOLOMA PARVIFLORA sp. n.

Densely long-pilose throughout; rhizome elongated, purple, not tuberiferous in my specimens; stem apparently ascending, slender, simple, sulcate, the internodes about 4 cm. long; petioles 1–1.5 cm. long; blades 4–8 cm. long, 2.5–5 cm. broad, ovate with rounded base and short-acuminate, acute apex, closely and sharply serrate, densely strigose; flowers few, in the upper axils and terminal, the pedicels slender, 1 or 2 cm. long; calyx-tube 4 mm. broad, hemispherical or shorter, the lobes 4 or 5 mm. long, 2 mm. broad, oblong, obtuse, herbaceous; corolla red-purple, 7 mm. long, 6 mm. broad, the narrow basal portion very short, the oblique mouth much narrower than the body, the reflexed lobes very short and broad; stamens barely exserted; disk of (always?) 8 globose brown glands, 6 of them united into three pairs, the others solitary to right and left of the lower pair; fruit not seen.

Mapiri, July–Aug., 1892 (1563a. Perhaps partly distributed as 1565.). This is very similar to, if not the same as, no. 544 previously enumerated, with doubt, as a *Besleria*. It is very near Spruce's 4962 from Chimborazo.

Alloplectus Patrisii DC. Prod. 7: 545. Espirito Santo, 1891 (1259) = Spruce's 2604, and a specimen in Herb. Kew. marked "ex Herb. Sagot 425."

Columnea Boliviana Rusby (See no. 515). Mapiri, July–Aug., 1891 (1551).

COLUMNEA OBLONGIFOLIA sp. n. (Sect. Pentadenia).

Branches purple, thick but weak, hirsute above, the internodes 2 or 3 cm. long; petioles .5–1 cm. long, very broad; blades .5–1.5 dm. long, 2.5–5 cm. broad, the pair moderately unequal, oblong, inequilateral, the base obtuse, the apex acute; coarsely and shortly serrate, densely short-strigose, purple underneath; pedicels 7–10 cm. long, slender, ascending, recurved; calyx densely strigose, 1.5 cm. long, cleft nearly to the base, the lobes linear-lanceolate, tapering from base to apex; corolla red-purple, tomentose, finely many-nerved, 5 cm. long or more, 1.5 cm. broad (as pressed), the tube short, lightly curved, expanding gradually into the ventricose body, the mouth slightly contracted and lobes erect-spreading, about 1 cm. long; stamens slightly exserted, the anthers globoidal, broader than long; style about as long as the corolla, dilated at the summit, the stigma truncate with circular summit; fruit not seen.

Vic. Mapiri, Jan., 1893 (1744). Near *C. strigosa.*

BESLERIA ROTUNDIFOLIA sp. n.

Glabrous; stems thick but weak, strongly sulcate, the internodes 4–5 cm. long; petioles 3–5 cm. long, broad; blades 1.25 to nearly 2 dm. long, nearly as broad, sub-orbicular, the base broadly cuneate, distantly beset with very small sharp salient teeth; flowers loosely paniculate-cymose in the upper axils and at the summit, the cymes mostly long-peduncled, 3 or 4 cm. long, not bracted, the pedicels .5–1 cm. long, enlarged upward, strongly quadrangular and sulcate; calyx 6 mm. long, 8 mm. broad, the tube very short, saucer-shaped, the lobes unequal and inequilateral, ovate, obtuse, more or less keeled, coriaceous or cartilaginous; corolla red-purple, 1 cm. long, 6 mm. broad, the base oblique and ventricose, the body nearly straight, the mouth slightly contracted, the small oval lobes spreading; stamens short; disk short, cupulate, sinuately lobed, deficient on one side; ovary broadly conical; fruit globose, 5 mm. in diameter.

Espirito Santo, 1891 (1250). Very similar to *B. ovalifolia* Rusby, but certainly distinct.

NAPEANTHUS ANDINUS sp. n.

Sparsely strigose-hirsute; stem rhizomatous, short, stout, the leaves crowded at the summit; leaves .3–1.5 dm. long, 1–3 cm. broad, inequilateral, obovate with long tapering petiole-like base and acute apex, obsoletely serrate, deep green, thin; peduncles filiform, recurved-spreading, 2–5 cm. long, bearing two or three branches, the bracts oblong-lanceolate, 5 mm. long, the pedicels filiform, 1–2 cm. long; calyx 5 mm. long, lobed two-thirds of the

way, the tube broadly campanulate, sharply many-nerved, the lobes triangular-ovate, acuminate and very acute; corolla white (?) the tube 5 mm. long, broadly campanulate, slightly ventricose, the broadly spreading or reflexed lobes nearly as long; fruit globose, brown, nearly as long as the calyx, tipped for some time by the capillary recurved style.

Between Tipuani and Guanai, Dec., 1892 (1729).

NAPEANTHUS RIGIDUS sp. n.

Stem of similar habit to the last, but stouter; leaves .5–1 dm. long, 1.5–3 cm. broad, oblanceolate, with cuncate sessile base and acute apex, coarsely short-serrate, the teeth mostly sharp, thick and rigid, glabrous and glaucous above, sparsely strigose underneath, the midrib and primaries very stout and prominent underneath; peduncles 1–1.5 cm. long, stout, erect, several-flowered, the bracts very thin, the longest 1 cm. long, tapering, lance-linear; pedicels rigid, erect, 1–2 cm. long; calyx 8 mm. long, lobed nearly to the base, sharply many-nerved, the lobes lanceolate, tapering from the base to a pungent apex, rigid; corolla little exceeding the calyx; capsule not more than half the length of the calyx, bright green.

Between Tipuani and Guanai, Dec., 1892 (1729a).

BIGNONIACEAE.

Lundia Spruceana Bureau in Baill. Adansonia, 8: (1867–68) 279. Between Tipuani and Guanai, Dec., 1892 (1672). Leaves slightly thicker and more reticulate than in Spruce's 4489.

LUNDIA PHASEOLIFOLIA sp. n.

Glabrous; branchlets red, striate, the internodes 5–7 cm. long; petioles 3–6 cm. long, slender, striate; leaflets 3, the petiolules .5–2 cm. long, the terminal more than twice the length of the lateral, blades 6–10 cm. long, 4–5 cm. broad, the base cordate, the lateral slightly inequilateral, the apex long-acuminate and acute, membranaceous and thin; bright green, the primaries about 5 pairs, prominent beneath, venation slightly and coarsely reticulate; panicles axillary and terminal, short and broad, the peduncles mostly shorter than the petioles, the slender pedicels about 5 mm. long; calyx of a little deeper yellow than the corolla, 6 mm. long, 5 mm. broad, campanulate, the margin truncate and obscurely sinuate; disk annulate, inconspicuous; corolla puberulent without, 4 or 5 cm. long, 2 cm. broad, not strongly 2-lipped, the mouth scarcely oblique; stamens reaching a little beyond the middle of the corolla, the anthers red-brown, pilose, the thecae divaricate; style about equalling the stamens, the stigma lozenge-shaped, broader above; fruit not seen.

Between Tipuani and Guanai, Dec., 1892 (1650). Also collected by Pearce in "woods near Salta" (sub *Bignonia* in Herb. Kew). Near *L. corymbifera.*

Bignonia brachypoda DC. Prod. 9: 145. Mapiri, July–Aug., 1891 (1500).

BIGNONIA IMPRESSA sp. n.

Glabrous; branchlets stout, terete; petioles 4–7 cm. long, stout, lightly angled; leaflets 3, the terminal petiolule about 2 cm., the lateral 1 cm. long, semi-cylindrical, hollowed with sharp edges upon the upper side, the blades 1–1.5 dm. long, about 5 cm. broad, the terminal longer, lance-ovate, the base rounded, the apex bluntly acuminate; strongly revolute, coriaceous and rigid, but not thick, dark-green and shining above, pale underneath, veins strongly impressed above, very prominent beneath, the principal primaries 5–7 pairs, the veins strongly and coarsely reticulate; panicle terminal, sessile, the pedicels 1–3 cm. long; disk cup-shaped; calyx thick, 1.5 cm. long, nearly 1 cm. broad at the apex, which is not oblique, campanulate, cleft nearly to the middle, the lobes unequal, entire; corolla 8 cm. long, 5 or 6 cm. broad at the oblique mouth, the tube broadly infundibular, slightly curved and ventricose; stamens reaching a little beyond the middle of the corolla, the style a little longer; style-branches 5 mm. long, oblong, broad, flattened; fruit oblong, 1.5 dm. long, 3 cm. broad, slightly compressed, lightly keeled; seed (exclusive of wing) about 2 cm. broad in each direction.

Between Guanai and Tipuani, Apr.–June, 1892 (1321). Apparently the same as Rusby's 1129, from which the descriptions of the fruit and seed are taken.

BIGNONIA PEARCEI sp. n.

(Sect. *Arrabidaea.*) Ferruginous-hirsute or tomentose throughout; branchlets short and very stout, terete, light brown; petioles 2–3 cm. long; leaflets 3, the petiolules .5–1 cm. long, the terminal one-half longer than the lateral, stout, the blades 1–1.5 dm. long, .5–1 dm. broad, ovate to rotund-ovate, the base very oblique and subcordate, membranaceous but rigid, above very sparingly hairy, underneath abundantly so with the veins and 5 pairs of primaries very prominent, frequently some of the lower primaries forked below the middle; panicles in the upper axils and terminal, short and broad, stoutly peduncled, many-flowered, the pedicels 3–5 mm. long, rather slender; disk cup-shaped, 2 mm. long; calyx campanulate, truncate, with entire border, 5 mm. long; bud obovoid with rounded or obscurely pointed apex; corolla 2.5 cm. long, the oblique mouth 1.5 cm. broad, infundibular-campanulate, puberulent with-

out, bright purple; stamens about as long as the corolla-tube, the anthers linear, the thecae divaricate; fruit not seen.

Between Guanai and Tipuani, Apr.–June, 1892 (1391). Also collected by Pearce at Palta. Near *B. Sieberi* DC.

BIGNONIA TECOMAEFLORA sp. n.

Glabrous; branches reddish-brown, striate, the internodes 5–10 cm. long; petioles 1–2 cm. long, angular, the leaflets a single pair, the petiolules half as long as the petioles; blades 5–7 cm. long, 3–4 cm. broad, ovate, the base rounded, the apex short-acuminate and acute, venation inconspicuous, the primaries 5 or 6 pairs, the surface finely pitted; rhachis in the form of a tendril, which is trifid at the summit; panicle ample, broad, lax, the branches sharply angled; pedicels 5–7 mm. long; calyx open-campanulate, 5 mm. long, 5-lobed, the lobes exceedingly short, mucronate; corolla coriaceous, deep red, 6 or 7 cm. long, infundibular, lightly curved and very slightly ventricose, the lobes recurved, oblong with rounded apex, which is pubescent within, the lower one exterior and slightly longer, nearly 2 cm. long; stamens lightly exserted by the recurving of the corolla-lobes, the anthers 4 mm. long, the thecae separated at the rounded base, lanceolate in outline; style slightly exceeding the stamens, the stigma ovate, 3 mm. long; capsule 2.5 dm. long, strongly flattened, smooth, lightly curved, acuminate and acute; seeds (inclusive of the wing) nearly 4 cm. long, 1 cm. broad, light brown with scarious entire margin.

Mapiri, July–Aug., 1892 (1510) and vic. Sorata, Sept., 1892 (1596).

Cuspidaria. The species apparently does not exist at Kew, but the specimens are without flowers. Mapiri, July–Aug., 1892 (1485).

Pithecoctenium Lundii DC. Prod. 9: 196. Between Tipuani and Guanai, Dec., 1892 (1668).

Amphilophium paniculatum (L.) H.B.K. Nov. Gen. 3: 149. (*Bignonia p.* L.; Jacq. Am. 183. *pl. 116.*) Between Tipuani and Guanai, Dec., 1892 (1739)=Morong's 446.

Tecoma mollis H.B.K. Nov. Gen. 3: 144. Vic. Sorata, March, 1892 (1315)=Rusby's 1128.

Crescentia —— sp. Espirito Santo, 1891 (1161).

ACANTHACEAE.

Mendoncia Lindavii Rusby. (See no. 532). Between Tipuani and Guanai, Dec., 1891 (1707).

Ruellia Willdenoviana Nees in DC. Prod. 11: 207. Espirito Santo, 1891 (1199).

Ruellia amoena Nees in DC. Prod. 11: 203. As syn. Espirito Santo, 1891 (1223). Between Guanai and Tipuani, Apr.–Juńe, 1892 (1390).

Ruellia ———*?* Espirito Santo, 1891 (1295). Dr. Lindau denotes this as an undescribed species of the Sect. Thysruellia, and will doubtless supply a description.

RUELLIA BANGII sp. n.

Closely strigose; root vertical, stout; stem erect, widely branching, sharply quadrangular and above narrowly winged, very dark green; petioles 1–2 cm. long; blades .75–1.5 dm. long, 2–4 cm. broad, ovate, varying greatly in comparative breadths, the base tapering acutely into the petiole, the apex acuminate and acute, dark green, thin, closely and rather sparsely (sub-equally on the two sides), short-strigose; calyx 1 cm. long, divided nearly to the base, the lobes unequal, narrowly lanceolate, tapering to an acute pungent apex, ciliate; corolla 4–6 cm. long, the tube slender, curved, the lobes very broad; stamens much shorter than the tube.

Between Guanai and Tipuani, Apr.–June, 1892 (1355).

It is very unfortunate that my material of this interesting species is so scanty and poor that a good dissection cannot be made. A better description will doubtless be given by Dr. Lindau.

RUELLIA GRACILIS sp. n. (Sect. Thysruellia.)

Minutely strigose; stems 2 or 3 dm. high, erect, slender, nearly simple, sharply quadrangular, the internodes 3 or 4 cm. long; leaves sessile, 3–5 cm. long, 3–7 mm. broad, linear-oblong, tapering at both ends, obtusish, entire, bright-green, erect; flowering branchlets 4 or 5 cm. long, very slender, erect, one-flowered or bearing several flowers sessile near the summit; calyx 7 or 8 mm. long, the tube very short, campanulate, the lobes more or less unequal, linear-setaceous, tapering to a very acute point, rigid, bright green, the sinuses several times broader, obtusish; corolla scarlet, 2 cm. long, the narrow basal portion 5 mm. long, dilated abruptly into the body, which is four times as broad, strongly ventricose on the lower side, the lobes short and broad, erect-spreading; stamens inserted near the base of the corolla, reaching to the base of the lobes, the anthers 1.5 mm. long, broad; fruit lance-oblong, acute, green, a little more than 1 cm. long.

Between Guanai and Tipuani, Apr.–June, 1892 (1449).

SANCHESIA PERUVIANA (DC.) (*Ancylogyne P.* DC. Prod. 11: 222.) Mapiri, July–Aug., 1892 (1473).

LOPHOSTACHYS CONFERTA sp. n.

Minutely and harshly strigose throughout; stems slender and weak, decumbent and rooting at the base, obscurely angled, the internodes about 5 cm. long; leaves 6–12 cm. long, 2–4 cm. broad, oval-ovate, the base abruptly contracted into a margined pseudopetiole 1–2 cm. in length, the apex about equally acuminate, acute or obtusish; entire, dark green; spikes very dense, 3–7 cm. long, about 2 cm. broad, sessile; bracts 1 cm. long, 4 mm. broad, highly inequilateral, ovate, falcate, abruptly contracted into a pungent acumination, green, with 4 or 5 very strong dark-green nerves, strongly reticulate and ciliate; the 2 larger calyx-lobes broadly obovate, shortly and pungently pointed, scarious with stout green nerves and veins, strongly ciliate, unequal, the larger 1.25 cm. long, nearly 1 cm. broad, cleft to the base; the two smaller setaceous, 6 mm. long; corollas of my flowers withered and unfit for dissection; style, exclusive of ovary, more than 1 cm. long, the stigma small; capsule (immature) on a narrow basal angled portion (stipe ?) nearly as long as the body, which is ovoid, acute, light-brown, glabrous, flattened, the flat surfaces broadly and bluntly keeled.

Vic. Guanai, July, 1892 (1604). The same as Rusby's 1114 from Mapiri.

Aphelandra tetragona (Vell.) Nees in DC. Prod. 11: 295. Between Guanai and Tipuani, Apr.–June, 1892 (1368).

BELOPERONE COCHABAMBENSIS sp. n.

Stem and leaves minutely and harshly strigose, the inflorescence long-pilose; stems elongated, decumbent and rooting at the base, obscurely quadrangular, sulcate, green, branching, the internodes 4 or 5 cm. long; petioles 1 or 2 cm. long, broad; blades .75–1 dm. long, 2–4 cm. broad, ovate, the base acute, the apex regularly acuminate and acute, irregularly sinuate, pale green; spikes solitary and sessile at the summits of the stem and slender branches, dense, the mass of bracts about 3 cm. long and half as broad; bracts leaflike, 1.5–2 cm. long, 6 mm. broad, obovate, shortly, abruptly and pungently acuminate; calyx 1.25 cm. long, the tube scarcely any, the lobes linear-setaceous, and very pungent, more or less unequal, green and long-pilose; corolla deep red-purple, puberulent, 4 cm. long, the tube infundibular, the lobes 1.5 cm. long; stamens nearly as long as the corolla.

Espirito Santo, 1891 (1215).

BELOPERONE NUDA sp. n.

Coarsely and sparsely strigose, the younger growth pubescent; stems herbaceous, tall, widely branching, obtusely quadrangular

and deeply sulcate, the internodes 4 or 5 cm. long; leaves sessile or sub-petioled by a short margined base, 1–2 dm. long, 4–7 cm. broad, oval-ovate, acuminate and acute at both ends, entire, thin, bright green, the 12–15 pairs of primaries regular, strongly falcate-ascending, the tip of one approximating or touching that next above very close to the margin, faintly connected by the secondaries; panicles axillary and terminal, the peduncles 1 dm. long, erect, angled, the floriferous portion about as long, broad, the subulate-setaceous bracts 2 or 3 mm. long, the pedicels .5–1 cm. long, erect; calyx 1 cm. long, lobed almost to the base, the lobes oblong, acutish, herbaceous but erect; corolla 5 cm. long, infundibular-cylindraceous, the longer lip 2.5 cm. long, its lobes 5 mm. long, rounded at the apex, the middle nearly twice as broad as the lateral, concave-arched, the shorter lip 2 cm. long, entire; stamens reaching to the middle of the lips, the anther-cells strongly overlapping, the caudae short, broad, white and translucent; style 7 mm. shorter than the stamens, the stigma small, obtuse; mature fruit not seen.

Mapiri, July–Aug., 1892 (1511). Species near *B. fragilis*.

Beloperone Bangii sp. n.

Stems erect, stout, terete, minutely strigose, green, swollen and dark purple at the joints, the internodes 3 or 4 cm. long; petioles 1 cm. long, broad, consisting of the abruptly contracted leaf-base; blades .6–1.25 dm. long, 3 or 4 cm. broad, ovate, acuminate and obtusish, entire, very short-strigose both sides, rather pale, drying brownish; spikes axillary and densely aggregated at the summit, dense, 6 or 7 cm. long, about 3 cm. broad, sessile or stoutly peduncled; bracts 2 or 3 cm. long, narrowly linear, tapering regularly to a most acute point, hispid and sparsely hirsute, grayish green; calyx 1.5 cm. long, divided nearly to the base, the lobes narrowly lanceolate or oblanceolate, tapering into an attenuate pungent point nearly as long as the body, keeled, rigid; corolla 5 or 6 cm. long; the tube very slender, the lobes 1 cm. long; stamens reaching to the middle of the corolla-lobes, the anther-cells approximate, appendages at apex and base well developed.

Espirito Santo, 1891 (1224). Apparently the same as Rusby's 1749 from the Beni River region. It appears also to be the same as Traill's 660 from San Antonio on the Madeira.

Justicia Boliviana sp. n. (Sect. Dianthera).

Glabrous, except the sparsely and coarsely strigose leaf-surfaces, especially the upper; stems weak, decumbent and rooting below, obscurely angled, very dark, the internodes 4–6 cm. long; lower petioles 2 or 3 cm. long, very slender; blades 5–10 cm. long,

2–5 cm. broad, oblong to oval-ovate, short-acuminate and acute at both ends, entire, dark green; spikes about 1 dm. long, very slender, erect, the peduncles longer than the petioles, rather loosely flowered; bracts setaceous, green, half as long as the calyx; calyx 1 cm. long, divided nearly to the base, the 4 lobes subequal or becoming very unequal in fruit, lance-linear, attenuate and pungent, green; corolla 1.5 to nearly 2 cm. long, the tube straight, slightly contracted near the middle, the lower lip 8 mm. long, its middle lobe distinctly larger, concave, the upper lip a little shorter, entire, concave; stamens a little shorter than the upper lip, the thecae approximate and subequal; style equalling the upper lip, the stigma small, but distinctly oblique; capsule oblanceolate, 1 cm. long, light brown; seed nearly 2 mm. long, ovoid, flattened, brown, light-muricate.

Espirito Santo, 1891 (1225). Apparently the same collected by Triana in New Granada, and a very similar one by Holton in Bolivia.

Pachystachys Riedeliana N. ab. E. in Endl. & Mart. Fl. Bras. Fasc. 7: 93. Mapiri, July–Aug., 1892 (1555).

JACOBINIA TENUISTACHYS sp. n.

Slightly strigose, the inflorescence pubescent, the upper leaf-surfaces glabrous; stems widely branching, the branches slender, lightly angled; leaves sessile, 1.25–2 (or probably more) dm. long, 4–6 cm. broad, ovate, the base slightly inequilateral, the apex acuminate and acute; entire, membranaceous, bright green, the primaries about 10 pairs, very slender, strongly falcate-ascending and connecting close to the margin; panicles in the upper axils and terminal, the slender erect peduncles 6 or 8 cm. long, the branches distant, widely spreading, very slender, the bracts and bractlets very small, varying from setaceous to subulate, the flowers distant and sessile; calyx 4 or 5 mm. long, deeply cleft, green, rigid, the lobes lanceolate, acuminate and acute; corolla scarlet, nearly straight, 2.5 cm. long; the lips nearly equal, 1 cm. long, nearly entire; stamens as long as the corolla, attached at about its middle, the filaments dilated at the base, the thecae parallel, nearly equal, attached at about the middle and separated by a short and broad connective; fruit not seen.

Between Guanai and Tipuani, Apr.–June, 1892 (1441). Nearly, if not the same as Lechler's 3153.

DIAPEDIUM MULTICAULE sp. n.

Sub-glabrous; primary root short and stout; stems numerous, erect or ascending from a broad crown, 3–6 dm. high, very slender, sharply quadrangular, green, the internodes 4–5 cm. long;

leaves sessile or on margined petioles 1 cm. long, 3–4 cm. long, 1–2 cm. broad, ovate, acute at both ends, entire, dark green; bracts numerous, 7–8 mm. long, 4 mm. broad, obovate, acute at base, the apex very shortly and very acutely pointed; light green, rigid; bractlets 7 mm. long, lanceolate, tapering to an acute point, scarious, greenish, ciliate; calyx 4 mm. long, scarious, white, the tube 1 mm. long, campanulate, the lobes lanceolate, tapering to a very acute point, ciliate, nerved; corolla pubescent, light purple, 1.5 cm. long, the lips nearly two-thirds of its length; stamens nearly equalling the lobes, the filaments broad, pubescent, the upper sterile theca the larger, broad, white; ovary ovoid-oblong, brown, 2 mm. long.

Vic. Cochabamba, 1891 (1001). The same as Mandon's no. 296.

VERBENACEAE.

LIPPIA CAESPITOSA sp. n.

Root vertical, slender, much elongated; stems and principal branches stout, very crooked, prostrate and rooting, terete, woody; leaves .5–1 cm. long, 2 or 3 mm. broad, oblanceolate, acute or acutish, very closely strigose or sericeous; peduncles a little shorter than the leaves, weak; heads 5 mm. broad; bracts green, ovate, acuminate and acute, 3 mm. long and nearly as broad; calyx 2.5 mm. long, 2-keeled, the margin truncate, but the keels slightly prolonged, hispid; corolla 4 mm. long, the tube as long as the calyx, cylindraceous-infundibular, nearly straight, very slightly ventricose, the larger lobe orbicular; pistil 1 mm. long, the cylindrico-conical style as long as the broadly ovoid ovary, the stigma small.

Vic. Cochabamba, 1891 (1009. Perhaps some accidentally distributed as 1008.).

LIPPIA LIPPIOIDES (Cham.) (*Riedelia lippioides* Cham. Linnaea, 7: 224 = *Lippia Chamissonis* D. Dieterich, Syn. Pl. 3: 598). Between Tipuani and Guanai, Dec., 1892 (1726).

Priva lappulacea (L.) Pers. Ench. 2: 139 (*Verbena l.* L. Sp. Pl. 19 = *Priva echinata* Juss. Ann. Mus. Par. 7: 69). Between Guanai and Tipuani, Apr.–June, 1892 (1375).

Verbena polystachya H.B.K. Nov. Gen. 2: 274. A little below Cochabamba, 1891 (1058).

Petrea bracteata Steud. in Flora (1843), 764. Mapiri, July–Aug., 1892 (1480).

Callicarpa acuminata H.B.K. Nov. Gen. 2: 252. Between Tipuani and Guanai, Dec., 1892 (1669).

AEgiphila tomentosa Cham. Linnaea, 7: 110. Between Tipuani and Guanai, Dec., 1892 (1332) = Rusby's 2516.

AEGIPHILA DENSIFLORA sp. n.

Harshly yellowish-scurfy and strigose; stems elongated, slender and weak, erect or somewhat ascending, obtusely quadrangular, the internodes about 3 cm. long; petioles divaricate, about 5 mm. long; blades 7–10 cm. long, 2–4 cm. broad, oblong, varying to obovate, the base rounded, the apex abruptly acuminate and tapering to a very acute point, short-strigose on both sides, the 10 pairs of primaries very prominent beneath, communicating near the margin and connected by the very crooked secondaries, the reticulation coarse and prominent; panicles stoutly peduncled, close or interrupted, the flowers crowded upon the branches into dense hemispherical secondary panicles, the bracts and bractlets setose, elongated, weak, acute; pedicels slender, mostly 5–7 mm. long; calyx 5 mm. long, the tube 3 mm. long, turbinate, the lips cleft half way, the lobes ovate, obtuse; corolla-bud strongly pyriform, the apex rounded; tube cylindraceous, 6 mm. long, 2 mm. broad, the lobes 3.5 mm. long, broadly ovate with rounded apex; stamens slightly longer than the corolla, but not exserted, attached just below the lobes; ovary black, scarcely 2 mm. long; style shorter than the stamens; fruit not seen.

Between Tipuani and Guanai, Dec., 1892 (1732). Very near *AE. cuspidata* Rusby.

LABIATAE.

Mesosphaerum uncinatum (Benth.) Kuntze, Rev. Gen. Pl. 527 (*Hyptis u.* Benth. Lab. Gen. et Sp. 80). Espirito Santo, 1891 (1236).

MESOSPHAERUM ARBOREUM (?) BRACTEOSUM n. var.

Differs from the type principally in its large oblong or oblanceolate floral leaves, of a brilliant purple on the upper surface, and its calyx of the same color. There is at Kew a specimen by Weir (no. 161) of the same, referred to *M. arboreum*, but it may perhaps better be regarded as a distinct species.

Mapiri, July–Aug., 1892 (1519).

Mesosphaerum lantanaefolium (Poit.) Kuntze, Rev. Gen. Pl. 525 (*Hyptis l.* Poit. Ann. Mus. Par. 7: 468. *pl. 29*). Between Guanai and Tipuani, Apr.–June, 1892 (1425).

Mesosphaerum odoratum (Benth.) Kuntze (See no. 270a). Mapiri, July–Aug., 1891 (1495).

BYSTROPOGON (?) AXILLARE sp. n.

Shrubby and intricately much-branched, the branchlets almost filiform, sharply angled, reddish; leaves .5–1 cm. long, 2–3 mm. broad, lance-oblong, the base tapering into a petiole 1 or 2 mm. long, the apex acutish, entire, revolute, 1-nerved, lightly canescent, green, strongly papillose; peduncles 3 mm. long, 1–3–5-flowered, the pedicels nearly as long, recurved; calyx 2 mm. long, turbinate, green, strongly 15-nerved, nearly equally 5-toothed, the teeth broadly ovate, acute; corolla 3 mm. long, the tube as long as the calyx, straight, broadly cylindraceous, the lobes short, rounded, strongly reflexed; stamens inserted just below the lobes, slightly exserted; style equalling the stamens, lightly cleft.

Turedon, 1891 (1125). Species near *B. andinum* Britton.

Gardioquia grandiflora H.B.K. Nov. Gen. 2: 314. Turedon, 1891 (1127).

Alguelagum tenuiflorum (Benth.) Kuntze (see no. 167). Near snow-line, Mt. Tunari, 1891 (1044).

Alguelagum salviaefolium (H.B.K.) Kuntze, Rev. Gen. Pl. 512. (*Sideritis s.* H.B.K. Nov. Gen. 2: 307.) Near snow-line, Mt. Tunari, 1891 (1108).

ALGUELAGUM AURIFERUM sp. n.

A large stout shrub, finely canescent upon the stems, inflorescence and lower leaf-surfaces; branches thick but weak, obtusely angled, the internodes 5–7 cm. long; petioles 1–2 cm. long, broad, the blades 1.5–2 dm. long, .5–1 dm. broad, ovate, the base blunt, the apex acuminate and acute; finely dentate, the alternate teeth minute, finely bullate and harsh above, underneath canescent and thickly sprinkled with brightly shining golden particles; panicles axillary and terminal, long-peduncled, very dense; calyx in flower 4 mm. long, 2 mm. broad, campanulate, lobed nearly to the middle, the lobes not very unequal, triangular-ovate, acute, canescent within and without; corolla 5 or 6 mm. long; style slightly exserted, the branches recurved; ovary 1 mm. long and broader at the apex, deeply lobed; fruiting calyx 1.5 cm. long and broad (as pressed); nuculae oval-ovoid, 2 mm. long, 1 mm. broad, deep purple-brown, smooth.

"Near snow-line, Mt. Tunari" (?) 1891 (1107).

SALVIA COCHABAMBENSIS sp. n.

Finely canescent throughout; shrubby, the branches elongated, erect, slender, purple at the base, sharply angled, the internodes 2.5–5 cm. long; petioles 3–5 mm. long, slender; blades 4–6 cm. long, .5–1 cm. broad, lance-oblong, tapering to a very acute point at both ends, crenate-dentate, thick, erect, the veins strongly im-

pressed above, yellowish and very prominent underneath, the erect primaries about 7 pairs, connected by the secondaries; pedicels stoutish, 3–5 mm. or in fruit about 1 cm. long, distantly racemed, 3–5 together; calyx (in flower) 1.25 cm. long, about 5 mm. broad, campanulate; corolla (deep purple-red?) tomentose, 3–4 cm. long, the upper lip 1.5 cm., the lower 1.25 cm. long, the points 2 cm. apart; style exceeding the stamens, densely pilose, the longer branch about 5 mm. long.

Vic. Cochabamba, 1891 (1059).

Stachys Bogotensis H.B.K. Nov. Gen. 2: 309. A little below Cochabamba, 1892 (1054).

PLANTAGINEAE.

Plantago sericea R. & P. Fl. Per. 1: 51. *pl. 79, B.* Vic. Cochabama, 1891 (1152).

NYCTAGINEAE.

Boerhaavia scandens L. Sp. Pl. 3. A little below Cochabama, 1891. With white flowers (1069) and with purple flowers (1070).

Boerhaavia erecta L. Sp. Pl. 3. Between Guanai and Tipuani, Apr.–June, 1892 (1431) = Rusby's 904.

BOUGAINVILLEA LONGISPINOSA sp. n.

Intricately branching, the branchlets stout, purple, terete, glabrous, very leafy; spines elongated, 1–2 cm., very slender and pungent, divergent; petioles about 5 cm. long; blades 1.5–3 cm. long, .75–1.5 cm. broad, the smaller obovate to oblong, the larger rhomboidally ovate, the base cuneate, apex acute or obtusish; entire, more or less 3-nerved by the exaggeration of the lower pair of primaries, thick, papillose, drying yellowish green; bracts (in fruit) 2 cm. long, or more, 1.5 cm. broad, oval-ovate, the base rounded, the apex blunt (color?); flowers 3, not seen; fruit (mature?) sub-sessile, 1 cm. long, 4 mm. broad, obovoid, triquetrous and sharply angled, green, bearing the marcescent corolla.

Turedon, 1891 (1123). The same collected by Pearce at Catamarca, in Nov., 1863.

Pisonia hirtella H.B.K. Nov. Gen. 2: 217. A little below Cochabamba, 1891 (1063).

AMARANTACEAE.

Chamissoa altissima (Swz.) Kunth in H.B.K. Nov. Gen. 2: 197. *pl. 125.* Between Guanai and Tipuani, Apr.–June, 1892 (1415) = Rusby's 1505.

Telanthera Moquinii Webb. ex. DC. Prod. 13: Part 2, 379. Between Guanai and Tipuani, Apr.–June, 1892 (1359) = Rusby's 1521.

TELANTHERA BANGII sp. n.

Villous; stems slender and weak, yellowish-green, the internodes 1–1.5 dm. long; petioles about 5–7 mm. long; blades 5–8 cm. long, 2–4 cm. broad, oval-ovate, very short-pointed, acute, entire, the venation inconspicuous; heads 1 cm. long, 8 or 9 mm. broad, ovoid, acutish, somewhat compound; bracts 2.5 mm. long, broadly ovate, concave, scarious, rigid, 1-nerved, very acute; calyx 4 mm. long, purple at the base, the lobes equal, oval-oblong with blunt apex, 1-nerved; androecium 2 mm. long, the appendages of the tube between the stamens oblong, long-fimbriate, a little longer than the filaments; pistil 1 mm. long, the ovary broadly ovoid; style conical; stigma rather large, peltate.

Near snow-line, Mt Tunari (?)1891 (1024).

Philoxerus sp.? Although very different from any other species of the genus, it appears to belong here. My specimens do not afford dissection material, and a positive determination cannot be made.

Mt. Tunari, 1891 (1084).

Gomphrena villosa Mart. Nov. Act. Nat. Cur. 13: (1826) 303. A little below Cochabamba, 1891 (1007). Vic. Sorata, May, 1891 (1301) = Mandon's 1016 and Rusby's 1518. I do not regard this as being the same as *G. perennis* L.

Hebanthe decipiens Hook. f. in B. & H. Gen. Pl. 3: 41 (*Iresine grandiflora* Hook.). Mapiri, July–Aug. 1892 (1521).

CHENOPODIACEAE.

Chenopodium foetidum Schrad. (See no. 799). A little below Cochabamba, 1891 (1004).

Basella rubra L. Sp. Pl. 272. Cochabamba (1062). Turedon (1103). (Cult.)

PHYTOLACCACEAE.

VILLAMILLA ROSEA-OENIA (Lem.) = *Ladenbergia r.* Lem. Illust. Hort. 16: (1869) *pl. 591.* Espirito Santo, 1891 (1292).

Microtea Maypurensis (Kunth,) G. Don; Loud. Hort. Brit. ed. 2, 98. Vic. Guanai, 1892 (1589) = Rusby's 1379.

POLYGONACEAE.

Polygonum lacerum H.B.K. (See no. 130). A little below Cochabamba, 1891 (1051).

Polygonum persicarioides H.B.K. Nov. Gen. 2: 179. Near snow-line, Mt. Tunari, 1891 (1025).

SARCOGONUM TAMNIFOLIUM (H.B.K.). (*Polygonum t.* H.B.K. Nov. Gen. 2: 180 = *Muhlenbeckia t.* Meissn. Gen. 2: 227.) Below Cochabamba, 1891 (1064). Espirito Santo, 1891 (1252).

TRIPLARIS HISPIDA Britton sp. n.

Branchlets purplish, slender, flexuous, fistulous, striate, sparsely long strigose-hispid with red hairs, papillose where these have fallen away; petioles 5–7 mm. long, very stout, erect, and, like the midrib underneath, clothed similarly to the branchlets; leaves 3 dm. or more long, 1 dm. broad, oblong with oblique base and abruptly short-acuminate apex, entire, rigid, glabrous except for the midrib, which is prominent on both sides, sparsely strigose underneath; spikes loosely panicled, with very stout rhachis, about 1 dm. long; bract of the staminate flower (only flowers seen) 3 mm. long, campanulate, at length completely fissured down the lower side, half-way along the upper, long-pilose; perianth pilose, the tube infundibular, 3 mm. long, 1.5 mm. broad at the summit, the lobes nearly 2 mm. long, oval-ovate with rounded apex; filaments long-exserted; fruiting calyx 3 cm. long, the tube 1.25 cm. long, lightly constricted above the fruit, densely ferruginous-hirsute, the lobes dark red, sparsely ferruginous-hirsute, linear-oblanceolate with rounded apex, the inner lobes 7 mm. long; fruit dark red, very sharply triquetrous, the styles stout, triquetrous, recurved-spreading.

Espirito Santo, 1891 (1169, fruit) = Rusby's 1424, from which the description of the flower is taken.

TRIPLARIS GUANAIENSIS sp. n.

A large tree, the branchlets fistulous, flexuous, light brown, their upper portions minutely verrucose, the inflorescence very densely and long ferruginous-pilose; petioles (only the uppermost leaves seen) 2 cm. long, very stout, channelled above like the midrib; blades 2.5–4 dm. long, .75–1.5 dm. broad, oblanceolate or obovate, the base acute and slightly inequilateral, the apex abruptly short-pointed; entire, thin and membranaceous but rigid, pale and above slightly glaucous, glabrous except upon the midrib of the younger leaves underneath, where there are a few fine hairs, the primaries 20–25 pairs, connected by very slender crooked secondaries; staminate spikes densely panicled, 2–2.5 dm. long, about 6 mm. broad

dense, cylindrical, uniform; bracts 3 or 4 mm. long and broad, ovate; calyx lightly pilose, 3 mm. long, lobed two-thirds of the way to the base, the tube campanulate, purple, the sub-equal lobes lighter, with dark middle portion, widely spreading, oval-obovate, acutish; stamens one-half longer than the calyx, the anthers elliptical-oval, less than 1 mm. long; pistillate spikes .5–1.5 dm. long, the flowers not seen; fruiting calyx densely hirsute, purple, 3.5 cm. long, contracted above the fruit, the outer lobes 2 cm. long, 5 mm. broad, oblong-oblanceolate with rounded apex, the inner 8 mm. long.

Vic. Guanai, July, 1892 (1600 in fruit, 1601 in flower). This is possibly the same as my 1243 from the lower plains, but I think not. That has regularly and broadly ovate cordate leaves which are not glabrous.

PIPERACEAE.

Piper umbellatum L. Sp. Pl. 30. Vic. Guanai, July, 1892 (1607) =Rusby's 2173.

Piper longistylosum C.DC. Bull. Torr. Bot. Club, 21: (1894) 161. Espirito Santo, 1891 (1233).

Peperomia pseudo-rufescens C.DC. Bull. Torr. Bot. Club, 21: (1894) 160. Vic. Cochabamba, 1891 (1148a).

Peperomia Mandonii excelsis C.DC. Bull. Torr. Bot. Club, 21: (1894) 160. Vic. Sorata, 1891 (1299).

Peperomia psilophylla C.DC. Bull. Torr. Bot. Club, 21: (1894) 160. Mapiri, 1892 (1516a).

Peperomia umbilicata macrophylla C.DC. Prod. 16: Part 1, 394. Espirito Santo, 1891 (1251a).

Peperomia hispidula (Sw.) A. Dietr. Sp. 1: 165. Between Tipuani and Guanai, Dec., 1892 (1719).

Peperomia magnoliaefolia (Jacq.) C.DC. Prod. 16: Part 1, 427. Between Guanai and Tipuani, Apr.–June, 1892 (1328).

MYRISTICACEAE.

Myristica sebifera (Aubl.) Swz. Fl. Ind. Occ. 1129. Between Tipuani and Guanai, Dec., 1892 (1678) = Rusby's 1216.

MONIMIACEAE.

*Siparuna Spruce*i A.DC. Journ. Bot. 3: (1865) 219. Between Tipuani and Guanai, Dec., 1892 (1640) = Spruce's 2777.

Siparuna nigra Rusby (See no. 844). Mapiri, July–Aug., 1892 (1523.)

Siparuna limoniodora (R. & P.) A.DC. Prod. 16: Part 2, 646 (*Citrosma l.* R. & P. = *Citrosma dentata* Poepp. et. Endl., but there is an uncertain *C. dentata* of R. & P. which has precedence. Espirito Santo, 1891 (1183).

LAURINEAE.

(Communicated by Dr. Karl Mez.)

Aniba bracteata (Nees) Mez. Laur. 66 (?) (*Aydendron bracteatum* Nees, Syst. 256 = *A. argenteum* Griseb. Fl. Brit. W. I. 285). Espirito Santo, 1891 (1180). Leaves only. One of the trees yielding "False Coto."

Persea gratissima Gaertn. Fruct. 3: 222. Espirito Santo, 1891 (1162).

PERSEA BOLIVIENSIS Mez et Rusby spec. nov.; foliis longe petiolatis, adultis supra glabris haud vel vix foveolatis, subtus tenuiter tomentellis, bene ellipticis, utrinque subrotundatis; inflorescentia pauciflora, dense adpresseque subferrugineo-tomentella, thyrsoidea, foliis permulto breviore; limbi segmentis valde inaequalibus; androeceo seriebus 2 exterioribus fertilibus, 2 interioribus sterilibus; filamentis ser. I., II., antheras duplo superantibus, pilosis; antheris fertilibus 4-locellatis; ovario glaberrimo, stylo manifeste longiore.

Arbor vel frutex, ramulis dense ferrugineo-tomentellis, subteretibus, gemmis ferrugineo-tomentosis, cortice paullo adstringente, esipido. *Folia* petiolis usque ad 40 mm. longis, supra leviter inciso-canaliculatis, ferrugineo-tomentellis stipitata, sparsa, coriacea, basi saepius minute asymmetrica, ± 0.2 m. longa, 80 mm. lata, penninervia, reti laxo subtus conspicue prominente, costis crasse prosilientibus e nervo medio sub angulo 45–60° prodeuntibus, margine paullo incurvulo. *Inflorescentia* dense ferrugineo-tomentella, brevissima pedunculata, pauciflora, anguste subthyrsoideo-paniculata, petioles paullo superans; pedicellis minutis, 1–2 mm. longis; bracteolis deciduis. *Flores* ± 7 mm. longi, flavescenti-subsericei; limbi segmentis exterioribus quam interiora subtriplo brevioribus. *Filamenta* ser. III., basi glandulis binis parvis, sessilibus praedita. *Antherae* ser. I., II., 4-locellatae, introrsae, ellipticoovatae, apice acutae; ser. III. specie biloculares revera indehiscentes steriles. *Staminodia* sagittata, filamento paullo longiore, dense piloso stipitata. *Bacca* (immatura solum suppetens) globosa, vix 7 mm. diam. metiens, perianthii lobis patentibus insidens.

Habitat in Bolivia ad Tipuani–Guanai, Dec., 1891 (1657, 1733).

Peraffinis *Perseae Peruvianae* Nees, solemniter tamen suis notis distincta.

Endlicheria dysodantha (R. & P.) Mez, Laur. 119. Between Tipuani and Guanai, Dec., 1892 (1676).

Endlicheria Szyszytoviczii Mez, Laur. 121. Between Tipuani and Guanai, Dec., 1891 (1691).

Ocotea Guyanensis Aubl. Pl. Gui. 2: 781. *pl. 310.* Between Guanai and Tipuani, Apr.–June, 1891 (1336 and 1715).

Ocotea Minarum Mart; Nees, Syst. 303. Vic. Sorata, Sept., 1892 (1571).

OCOTEA ALBIDA Mez et Rusby spec. nov.; foliis rigidiuscule coriaceis, adultis supra glabris subtus omnino albidis perobscureque adpresse tomentellis, ellipticis, utrinque obtusiusculis vel apice obscure lateque acuminulatis demumque rotundatis, penninervibus, supra immerse subtus prominulo-costatis ceterum laevibus; inflorescentia abbreviata, subample paniculata, dense adpresseque tomentella omnino alba vel cinerea, folia subaequante vel iis breviore; filamentis ser. exterioris antheras ovatas, rotundatas sequantibus, dense pilosis; staminodiis stipiti formibus, dense pilosis; ovario in flore ♂ suppetente glabro, reducto.

Arbor vel frutex ramulis tenuissime peradpresseque ferrugineo-tomentellis, junioribus leviter angulatis adultis teretibus; gemmis subsericeo-tomentosis; cortice aromatico, subpiperato. *Folia* petiolis usque ad 15 mm. longis, profunde canaliculatis, glabris stipitata, sparsa ± 1.1 dm. longa, 35 mm. lata, supra bene viridia pernitida; costis e nervo medio sub angulo 45–60° prodeuntibus, margine minute incurvulo. *Inflorescentia* pedicellis vix 2 mm. longis, bracteolis deciduis. *Flores* dioici, ♀ ignoti, vix ultra 2.5 mm. longi, dense albo-tomentelli; perianthii tubo brevi, obconico, apice nullo modo constricto, basi in pedicellum sensim transeunte.

Limbi segmenta brevia, squamiformia, subrotundata, aequalia. *Filamenta* ser. III. basi glandulis binis conspicuis, subcordatis, solemniter stipitatis aucta. *Antherarum* locelli normaliter dispositi. *Fructus* baccatus, fere 20 mm. longus, crasse ellipsoideus, basi cupulae crassae, simplicimarginatae, haud rugosae insidens; cotyledonibus sapore adstringenti- aromatico, quam maxime mucoso.

Mapiri, July–Aug., 1892 (1550). Between Tipuani and Guanai, Dec. (1646).

Obs. Proxima *Ocoteae argenteae* Mez, sed foliorum forma, inflorescentiae dense albo-tomentellae habitu, staminibus valde pilosis, staminodiis conspicuis, glandulis longe stipitatis bene distincta.

OCOTEA BANGII Mez et Rusby spec. nov.; foliis chartaceis, glaberrimis, utrinque subnitidis, late ellipticis, basi acutiusculis apice breviter sed manifeste acuminatis, penninervibus, glaberrimis, utrinque sed praesertim subtus prominulo-reticulatis; inflorescentia non nisi fructifera cognita ut videtur pauciflora, abbreviata. *Arbor* vel frutex ramulis glaberrimis, teretibus, gemmis flavido-pilosis, cortice brunneo, esipido. *Folia* petiolis usque ad 15 mm. longis stipitati, ± 0.13 m. longa, 60 mm. lata, sicca olivaceo-viridia, costis e nervo medio sub angulo 50-70° prodeuntibus, margine subpleno. *Flores* ignoti, absque dubio dioici. *Bacca* atra, crasse ellipsoidea, ± 13 mm. longa, 9 mm. diam. metiens, apice optime rotundata nec mucronulata, cupulai pateriformi, simplicimi, laevi, apice sinuatim in pedicellum valde auctum incrassatumque transeunti insidens.

Between Tipuani and Guanai, Dec., 1892 (1674).

Obs. Verisimiliter *Ocoteae laxiflorae* Mez, proxima, cui abhorret cupulae forma.

Nectandra laevis Mez, Laur. 45. Between Tipuani and Guanai, Dec., 1891 (1680).

Nectandra reticulata (R. & P.) Mez, Laur. 404. Between Guanai and Tipuani, Apr.–June, 1892 (1536).

Nectandra Pichurim (H.B.K.) Mez, Laur. 449. Between Guanai and Tipuani, Apr.–June, 1892 (1396).

NECTANDRA CITRIFOLIA Mez et Rusby spec. nov.; foliis adultis glaberimis, supra glauco-viridibus subtus ferrugineo-rubentibus, ellipticis, praesertim apice breviter lateque acuminatim acutis, utrinque minutissime immerse reticulatis; inflorescentia pauciflora brevissime tomentella; floribus hermaphroditis, strigoso-tomentellis, vix 5 mm. diam. metientibus; filamentis staminum ser. exteriorum nullis; ovario glaberrimo, ampulliformi, stylo subnullo.

Arbor vel frutex ramulis junioribus minute strigoso-tomentellis, adultis cortice laevi, cinereo, paullo aromatico obtectis. *Folia* petiolis usque ad 10 mm. longis, permanifeste canaliculatis stipitata, sparsa, chartacea, ± 90 mm. longa, 40 mm. lata, penninervia, venulis tenuissimis immersis neglectis adultis saltem laevia, costis e nervo medio sub angulo 45–55° prodeuntibus, margine minute recurvulo. *Inflorescentia* pauci-(infra 10-) flora, saepissime subracemosa, adpresse minuteque tomentella, foliis multo brevior; pedicellis 2–5 mm. longis, bracteolis deciduis. *Flores* perianthii tubo brevissimo late obconico. *Limbi segmenta* elliptica, acutiuscula vel subrotundata. *Filamenta* ser. III., glabra, basi glandulis binis maximis, compressis aucta. *Antherae* ser. I., II. reniformes apice rotundatae minutissime papillosae locellis omnibus introrsum dehiscentibus. *Staminodia* minuta, stipitiformia. *Ovarium* stigmate obtuso-pulvinato. *Fructus* ignotus.

Between Tipuani and Guanai, Dec. (1673).

Obs. Ex affinitate *Nectandrae Riedelii*, *psammophilae* et praesertim *Brittonii*, floribus tamen permanifeste strigoso-tomentellis, ne reliqua proferam, optime distincta.

PROTEACEAE.

Rhopala Gardneri Meissn. in Mart. Fl. Bras. 5: Part 8, 3. *pl. 31*. Mapiri, July–Aug., 1892 (1528).

PANOPSIS SPRUCEI Meissn. Ms. in Herb. Kew.

Branches light gray, the young growth, like the petioles and inflorescence red-ferruginous-tomentose; leaves sub-verticillate, the petioles stout, broad, 1 cm. long, the blades .75–1.5 dm. long, 2–5 cm. broad, oblong, inequilateral, the base acute, the apex apiculate; entire, thick, bright green above, reddish underneath, prominently reticulate; peduncles terminal, erect, stoutish, bearing solitary or verticillate racemes about 1 dm. long; flowers irregularly distributed, the pedicels 3–5 mm. long, divergent, not bracted; bud clavate-pyriform, obtuse, 3 mm. long; perianth divided to the base, the 3 divisions 4 mm. long, linear-oblanceolate, the apex rounded, strongly recurved and spirally twisted, the stamens nearly as long as the perianth, inserted near its base, the filament nearly as broad as the perianth-division, the anther less than 1 mm. long; pistil red-tomentose, the ovary 1 mm. long, the stout style nearly 5 mm. long, the stigma capitate.

Between Tipuani and Guanai, Dec., 1892 (1686). The same as Spruce's no. 1817 and very near *P. rubescens* Pohl.

Loranthus flexile Rusby (See no. 468). Between Tipuani and Guanai, Dec., 1892 (1659).

Loranthus eugenioides H.B.K. (See no. 6). Vic. Cochabamba, 1891 (1155).

STRUTHANTHUS NUDIPES sp. n.

Glabrous, the leaves papillose on both sides; branchlets slender, terete, grayish-brown; petioles about 5 mm. long, broad; blades 2.5–4 cm. long, 1–2 cm. broad, ovate with rounded base and acute apex, entire, thick and coriaceous, dark-green, the venation indistinct; spikes 4–6 cm. long inclusive of the strongly angled weak peduncles, which constitute from a half to three-fourths of their length, loosely flowered, the flowers ternate, the trio and the flowers sessile, the rigid bracts 1 mm. long, broadly ovate, very acute, bractlets none; bud 4 mm. long, narrowly clavate-pyriform, obtuse; calyx 1 mm. long, the tube hemispherical, the limb reduced to a whitish sub-entire ring; petals six, distinct, 5 mm. long, linear-oblanceolate, obtuse, plane, naked,

recurved and again incurved toward the summit, thick, yellowish; stamens inserted at about one-third above the base, three of them two-thirds the length of the petals, the filaments half as long as the anther, thick, the others nearly as long as the petals, with subulate filaments, the anthers versatile; style stout, about as long as the shorter stamens, the stigma capitate, very small.

Between Tipuani and Guanai, Dec., 1892 (1637). The species is intermediate between *S. polyanthus* and *S. marginatus*. It is the same as Miers' no. 4307, in Herb. Kew. as *S. syringaefolius*, and Burchell's no. 2011 from the Organ Mts. It is not the same as Gardner's no. 53.

STRUTHANTHUS MAPIRENSIS sp. n.

Glabrous; petioles 5 mm. long, broad; blades 5–8 cm. long, 1.5–2.5 cm. broad, oblanceolate, acute or obtusish, mostly a little inequilateral, fleshy, pale, the midrib impressed above, prominent underneath, venation inconspicuous; racemes axillary and clustered at the summit, peduncled, .5–1 dm. long, loosely flowered, the peduncle of the trio stout, divergent, 3–5 mm. long, the flowers sessile in the bracts; bracts distinct, large, foliaceous; bud 1.5cm. long, slenderly clavate, acutish; calyx-tube 3 mm. long, cylindraceous, striate, dark brown, the limb narrow, whitish, spreading, sinuate; petals 6, yellow, 1.4 cm. long, linear, spreading; stamens inserted at the junction of the lower third; filaments nearly as broad as the petals; anthers short, ovoid; style stout, angled.

Mapiri, July–Aug., 1892 (1569). The same as Lechler's no. 2626.

Phoradendron Mandoni Eichl. in Mart. Fl. Bras. 4: Part 2, 124

Between Tipuani and Guanai, Dec., 1892 (1717).

PHORADENDRON SUBTRINERVE sp. n.

Stems stout, yellowish, the younger portions minutely scabrous, flattened and broadened toward the summits of the internodes, which are 3–5 cm. long; petioles 5–7 mm. long; blades 2–4 cm. long, 1.5–3 cm. broad, rotund-obovate, the base very abruptly contracted, then tapering into the petiole, the apex rounded, the margin crumpled, thick, faintly 3-5-nerved by the prominent primaries; spikes 2 or 3 cm. long, including the stout peduncles, which comprise nearly half the length, erect-spreading; rhachis only slightly thickened, the flowers lightly immersed; flowers (the pistillate only seen) 1.5 mm. in diameter, 3- or 4-parted; perianth-lobes very short and thick, obtusish, slightly recurved; ovary very small, the stigma comparatively large, closely sessile; fruit white, 5–7 mm. broad.

Mapiri, July–Aug., 1892 (1549). This is the same as Fendler's No. 1116, in Herb. Kew. under *P. ellipticum*, and is intermediate between that species and *P. emarginatum*. It is nearly related to a specimen collected by Pearce at Carapai.

EUPHORBIACEAE.

Euphorbia geniculata Orteg. (See no. 232). Vic. Guanai, 1892 (1584).

Euphorbia dentata Michx. Fl. Bor. Am. 2: 211 (?). Vic. Mapiri, 8,000 ft., Jan., 1893 (1743).

Euphorbia lasiocarpa Klotsch, Nov. Act. Nat. Cur. 19: Supp. 1: (1843) 414. Between Guanai and Tipuani, Apr.–June, 1892 (1458)= Mandon's 1063.

Phyllanthus orbiculatus L. C. Rich. Act. Soc. d'Hist. Nat. Par. (1792) 113. Vic. Guanai, July, 1892 (1590)= Rusby's 903.

Phyllanthus lathyroides H.B.K. (See no. 335). Mapiri, July–Aug., 1892 (1518).

PHYLLANTHUS INEQUALIS sp. n.

Glabrous; shrubby, the branchlets light gray, slender; leaves exceedingly unequal, the petioles .5–1.5 cm. long, filiform, the blades 1–6 cm. long, .5–3 cm. broad, ovate or some oval, the base rounded, apex blunt; entire, very thin, pale-green above, glaucous underneath, the venation slender; apparently dioecious, only the staminate flowers seen, these clustered upon short leafless tubercle-like branchlets, the capillary pedicels .5–1 cm. long; perianth 3-bracted, the bracts highly unequal, ovate, obtuse, concave, sub-hyaline, closely appressed; perianth 4–5 mm. broad, whitish, 6-parted, the outer divisions smaller and firmer, oval; disk crateriform with sinuate border, thickish, rigid; ovary none; filaments monadelphous, the anthers forming a circle, 6 or more (rarely 5), small, yellow; rudimentary stigma enclosed by the anthers, circular, peltate.

Between Tipuani and Guanai, Dec., 1892 (1704). Species apparently near *P. nutans* Swartz, and with a structure much like that of *P. Martii*.

Jatropha Curcas L. (See no. 626). Mapiri, July–Aug., 1892 (1558).

Jatropha urens L. Sp. Pl. ed. 2, 1006. Between Guanai and Tipuani, Apr.–June, 1892 (1376).

Jatropha clavuligera Muell. Arg. Linnaea, 34: (1865–66) 209. A little below Cochabamba, 1891 (1083)=Mandon's 1073.

Croton sp. = Pohl's 1613, 1614 in part, and 1624. In Flora Bras., none of these numbers is cited, nor can I find a description to fit the plant, which is near *C. pungens*. But it appears probable that it is somewhere described. Between Guanai and Tipuani, Apr.–June, 1892 (1343).

CROTON RUSBYI Britton, sp. n.

A large shrub or small tree; branchlets stout, marked with the prominent triangular leaf-scars; petioles crowded at the summits of the branchlets, .5–1 dm. long, slender, glabrous; blades 1–2 dm. long, .5–1 dm. broad, regularly ovate with rounded base and short-acuminate obtusish apex, entire, membranaceous, deep green, glabrous, the midrib and 6–8 pairs of primaries slender and prominent both sides; panicles in the upper axils, appearing as though clustered at the summit, 2 or 3 dm. long, narrow, on short stout sulcate peduncles, gray-scurfy; bracts subulate, 1 mm. long; pedicels 1–2 mm. long, slender: bud depressed-globose, nearly 2 mm. broad; calyx lobes 2 mm. long, ovate, acute, tomentose both sides; petals about equalling the calyx-lobes, tomentose; stamens (of st. fls.) shorter than the petals, about 15, the filaments filiform, red, pubescent, the anthers globose; ovary (of pist. fls.), 3-lobed upon the summit, gray-scurfy, the red styles 2-cleft two-thirds of the way, the branches strongly recurved.

Between Tipuani and Guanai, Dec., 1892 (1664). The same as Rusby's no. 1224 from Mapiri.

Acalypha mollis H.B.K. Nov. Gen. 2: 94. Vic. Sorata, May, 1892 (1316) = Rusby's 1257, at least in part.

ACALYPHA FLABELLIFERA sp. n.

Coarsely hispid-strigose and slightly ferruginous throughout; branches stout, purplish, the internodes 3–4 cm. long; petioles 3–6 cm. long, very stout, ascending; blades 1–2 dm. long, .75–1 dm. broad, ovate, cordate with mostly closed sinus, acuminate, finely crenate-dentate, sub-five-nerved from the summit of the petiole, the midrib bearing about 5 additional pairs of strongly ascending primaries; staminate spikes axillary, 1–1.5 dm. long, 4 mm. broad, dense, the bracts ovate, acuminate and acute, 2 mm. long; flowers 1.5 mm. broad, densely pilose; pistillate flowers at the base of the staminate spikes, enclosed in bracts which are curved to form two campanulate truncate spathes, a little more than 1 cm. long and broad, herbaceous, numerously and strongly flabellate-nerved.

Near snow-line, Mt. Tunari (?) 1891 (1109). The same collected in Bolivia by Pearce. Species near *A. cuspidata*.

Acalypha sp. probably undescribed, but the buds are in so young a state that a description cannot be drawn up. Vic. Guanai, July, 1891 (1591).

Acalypha —— species near *A. multispicata* Wats. Vic. Cochabamba, 1891 (1081).

Acalypha —— may be the same as no. 676. Mapiri, July–Aug., 1892 (1548).

Manihot Aipi Pohl, Pl. Bras. 1: 29. *pl. 23*. Between Guanai and Tipuani, Apr.–June, 1891 (1364)=Rusby's 886. Vic. Cochabamba, 1891 (1241).

Alchornea triplinervia Muell. Arg. (See no. 210). Between Guanai and Tipuani, Apr.–June, 1891 (1466).

Mabea fistulifera Mart. Reise Bras. 479. Between Guanai and Tipuani, Apr.–June, 1892 (1333).

Dalechampsia scandens L. Syst. ed. 13, 720. Between Guanai and Tipuani, Apr.–June, 1892 (1434)=Rusby's 1347.

URTICACEAE.

Celtis Iguancus (Jacq.) Sargent, Silva, 7: 64, ex Rusby Ms. = *Rhamnus I.*, Jacq. Am. 74 (1763)= *Rhamnus aculeatus* Swz. Prod. Veg. Ind. Occ. 53. Mapiri, July–Aug., 1892 (1539).

Chlorophora tinctoria (L.) Gaud. Freyc. Voy. Bot. 508, in note (*Morus t.* L. Sp. Pl. 986). Between Tipuani and Guanai, Dec., 1892 (1652 and 1737) = Rusby's 1284.

Ficus Radula Willd. Sp. Pl. 4: 1144. Between Tipuani and Guanai Dec., 1892 (1665).

HELICOSTYLIS TOMENTOSA (Poepp.) (*Olmedia t.* Poepp. Nov. Gen. 2: 32. *pl. 145* (1838) = *Helicostylis Poeppigianus* Trécul, Ann. Sci. Nat.. III. 8: 136 [1847]). Between Tipuani and Guanai, Dec., 1892 (1696).

Urera baccifera (L.) Gaud. Freyc. Voy. Bot. 497. Espirito Santo, 1891 (1209). Vic. Guanai, July, 1892 (1609).

Urera laciniata Wedd. Ann. Sci. Nat. III. 18: 203. Vic. Cochabamba, 1891 (1247).

Phenax Sonnerattii Wedd. in DC. Prod. 16: Part 1, 235. Vic. Sorata, May, 1892 (1308).

PHENAX GLOBULIFERA sp. n.

Branchlets and young growth minutely canescent, otherwise

glabrous; branchlets elongated, very slender, terete, light brown, slightly flexuous, the internodes 1.5–2.5 cm. long; stipules 3–5 mm. long, lanceolate, attenuate, brown, scarious and deciduous; petioles .5–1 cm. long, very slender, partially concealed by the inflorescence; blades 6–8 cm. long, .75 to 1.5 cm. broad, lanceolate with sub-rotund base and attenuate apex, coarsely and sharply short-serrate, dark green, strongly 3-nerved, the remaining venation inconspicuous; heads of a rich brown, 7 or 8 mm. in diameter, very dense, closely enveloping the node and the base of petiole; bracts 1.5 mm. long, .5 mm. broad, oblong, obtuse; akene (flowers not seen) less than .5 mm. long, whitish, the stigma more than 3 mm long.

Espirito Santo, 1891 (1191).

Parietaria debilis Forst. Fl. Ins. Aust. Prod. 387. Vic. Cochabama, 1891 (1099).

BURMANNIACEAE.

Burmannia tenella Benth. in Hook. Kew Journ. Bot. 7: (1855) 10. Mapiri, July–Aug., 1892 (1563).

ORCHIDEAE.

(Determined by Mr. R. A. Rolfe.)

Humboldtia ruscifolia (L.) Kuntze, Rev. Gen. Pl. 669. Mapiri, July–Aug., 1892 (1567).

PLEUROTHALLIS COMPLICATA Rolfe sp. n.

Stems slender, terete, 6–8½ in. long. Leaves sessile, ovate-lanceolate, subobtuse, 5–7 in. long, 1–2½ in. broad. Racemes several from the axil of each leaf, the base covered with a persistent sheath, ¾ in. long, slender, longer than the leaves, many-flowered. Bracts tubular-infundibular, obtuse, 1 lin. long. Pedicels 1 lin. long. Dorsal sepal lanceolate-oblong, subacute, 1¾ lin. long; lateral ones connate to apex, subacute, base very concave, 1 lin. broad. Petals linear, acute, 1½ lin. long. Lip orbicular, complicate, the apical half being abruptly deflexed under the basal one, with the rounded sides erect, apex subobtuse. Column short and stout.

Mapiri, n. 1568.

Closely allied to the Venezuelan *P. semipellucida* Rchb. f., and having a similar dwarf lip, which is curled up in the sac of the united lateral sepals, yet the two are quite distinct in various details of the flower.

HEXADESMIA BOLIVIENSIS Rolfe sp. n.

Stems branched, internodes slender, 3–7 in. long, apex 2-leaved. Leaves linear, obtuse, 4–6 in. long, 2–3½ lin. broad. Flowers in fascicles of 1–4; pedicels slender, 5–7 lin. Bracts lanceolate, acuminate, 1½ lin. long. Sepals lanceolate, acute, 3 lin. long, the lateral ones a little broader and subfalcate. Petals linear-lanceolate, acute, 3 lin. long. Lip obovate-spatulate, 3-lobed, 3 lin. long, 1¼ lin. broad; lateral lobes rounded; front lobe roundish-oblong, emarginate; disc with five slender linear undulate keels. Column slender, arcuate, 2½ lin. long. Chin oblong, obtuse, ½ lin. long.

Between Guanai and Tipuani, n. 1329.

Allied to *H. stenopetala* Rchb. f., but rather stouter, the leaves broader, and the flowers twice as large. The pollen has all been removed, but the plant has precisely the habit of this genus; which, however, closely resembles *Scaphyglottis* in habit.

Epidendrum paniculatum R. & P. Syst. Veg. 243. Mapiri, July–Aug., 1892 (1552).

Epidendrum Schomburgkii Lindl. Bot. Reg. (1838) Miscel. 15. Espirito Santo, 1891 (1284 and 1284a).

ONCIDIUM PUSILLUM (L.) (*Epidendrum p.* L. Sp. Pl. ed. 2: 1352 = *Oncidium iridifolium* H.B.K. Nov. Gen. 1: 344). Between Guanai and Tipuani, April–June, 1892 (1330).

Selenipedium caricinum (Lindl. & Paxt.) Reichb. f. Bonplandia 2: (1854) 116 = *Cypripedium c.* Lindl. and Paxt. Fl. Gard. 1: 39 (1850–51). Espirito Santo, 1891 (1285).

Habenaria maculosa Lindl. Gen. et. Sp. Orch. 309. Espirito Santo, 1891 (1239).

RUSBYELLA Rolfe n. gen.

Sepals suberect, the lateral ones connate for two-thirds their length. Petals suberect. Lip erect, with a long narrow unguis, which is bordered with a narrow membranaceous border below the middle, and above this three tooth-like appendages, two of them lateral; terminal limb broadly cordate. Column footless, clavate, truncate, nearly wingless; anther oblong, stipes of pollen slender.

A new genus allied to *Cohnia* Rchb. f., and *Sigmatostalix* Rchb. f., but differing in various details of the flower. The structure of the lip is very curious.

RUSBYELLA CAESPITOSA Rolfe sp. n.

Pseudobulbs densely tufted, ovoid-oblong, subcompressed,

12–15 lin. long, apex monophyllous, base diphyllous. Scapes lateral, 6–7 in. long, occasionally with one or two lateral branches, loosely racemose. Bracts triangular-lanceolate, acute, scarcely 1 lin. long. Pedicels 2½ lin. long. Sepals linear-lanceolate, acute, 2½ lin. long. Petals spathulate-lanceolate, acute, 2½ lin. long. Lip 2½ lin. long, limb shorter than the unguis. Column 1½ lin. long.

Specimens without number.

SCITAMINEAE.

Costus spicatus (Jacq.) Sw. (See no. 912) Espirito Santo, 1891 (1248).

Etherium racemosum (R. & P.) Kuntze, Rev. Gen. Pl. 689 (*Amomum r.* R. & P. Pl. Per. = *Renealmia* Rosc. ex Griseb. Flor. Brit. W. I. 601). Espirito Santo, 1891 (1237). Between Tipuani and Guanai, Dec., 1891 (1658).

Calathea Mansonis Koern. Bull. Soc. Nat. Mosc. 35: (1862) Part 1, 119. Between Tipuani and Guanai, Dec. 1892 (1660). Kindly determined by Mr. Spencer Moore.

CALATHEA PEARCEI sp. n. (Sect. Eucalathea).

Glabrous; rhizome horizontal, short, stout; culm sheathed at the base by about 3 obtuse thin scarious finely many-nerved leaf-sheaths; culm 3–6 dm. high; leaf-sheaths 4 or 5 cm. long, extended on each side into a blunt appendage 3 mm. long, at the base of the petiole, which is 5 mm. long, very stout and tomentose upon the upper side; blades .75–1.5 dm. long, 3 or 4 cm. broad, oval-ovate, acute, pseudo-pinnately-veined; peduncle 6–10 cm. long, sharply striate; heads 1.5–3 cm. broad, the bracts 1 cm. long, broadly ovate, obtuse, finely many-nerved; flowers a little more than 1 cm. long, the corolla double the length of the calyx, the petals, especially the larger, crenate.

Between Tipuani and Guanai, Dec., 1892 (1723a). Collected by Pearce at Yungas, 3000–4000 ft., Jan., 1866. The same as Rusby's no. 2233.

Canna glauca L. Sp. Pl. 1. Espirito Santo, 1891 (1281.)

BROMELIACEAE.

(Communicated by Mr J. G. Baker.)

Pitcairnea Lehmanni Baker, Handb. Brom. 164. Between Guanai and Tipuani, Apr.–June, 1892 (1352).

PITCAIRNIA (PUYOPSIS) BANGII Baker, sp. n.

Basal leaves ensiform, very rigid, 2½–3 ft. long, 1½ in. broad at the base, narrowed gradually to the point, glabrous on both surfaces, armed on the margin with curved ascending brown horny slender spines ⅛ in. long. Inflorescence panicled; racemes lax, subsecund, reaching a length of 8–9 in.; their rachises white-floccose; branch-bracts oblong, cuspidate, serrated, 2–3 in. long; flower-bracts ovate-cuspidate, scarious, glabrous, 1–1¼ in. long; pedicels ½–¾ in. long, white-floccose like the rachis. Sepals lanceolate, glabrous, above 1 inch long. Petals protruded ½ inch beyond the calyx, curled up spirally as the flowers fade.

Near *P. Rusbyi* and *P. Weddeliana* Baker, Handb. Bromel. 122, both plants of the Bolivian Andes. Vic. Sorata, Nov. 1892 (1631).

PUYA MOLLIS Baker, sp. n. (ex Mez Mon. Brom. 488).

Basal leaves ensiform, very rigid, 2½–3 ft. long, 2 in. broad at the base, tapering gradually to a long point, quite glabrous on both surfaces, armed on the margins with curved ascending horny prickles, those at the base of the leaf ¼ in. long, the upper growing gradually smaller. Inflorescence panicled; spikes moderately dense, 4–6 in. long; rachis and bracts clothed with soft white woolly pubescence; flower-bracts oblong-mucronate, entire, the upper 1 in., the lower above 1½ in. long; pedicels densely pubescent, ⅓–½ in. long; calyx densely persistently pubescent, 1 in. long; sepals oblong, obtuse, much imbricated. Petals oblong, unguiculate, obtuse, twice as long as the calyx, apparently greenish-white. Stamens distinctly shorter than the petals.

Near *Puya vestita* Andre; Baker, Handb. Bromel. 125. Vic. Sorata, Nov., 1892 (1629).

Guzmannia monostachya (L.) Rusby, ex Mez Mon. Brom. 905. = *Tillandsia m.* L. *fide* Baker, Handb. Brom. 152 = *Guzmannia tricolor* R. & P. Fl. Per. 2: 38. *pl. 26.* Vic. Mapiri, 10,000 ft., Sept., 1892 (1582).

Tillandsia recurvata L. Sp. Pl. 287. Vic. Cochabamba, 1891 (1154a) = Mandon's 1177. (Dr. Mez regards this as *T. Cordobensis* Hieron.)

Tillandsia stricta Soland. et Sims. Bot. Mag. *pl. 1529* (1813), *not* Lindley, 1830. Vic. Sorata, Nov., 1892 (1628). (Dr. Mez regards this as *T. pulchella rosea* Mez.)

TILLANDSIA (ALLARDTIA) BANGII Baker, sp. n.

Basal leaves lanceolate, entire, chartaceous, ½ ft. long, 2 in.

broad at the middle, narrowed gradually to the acute point, hardly at all lepidote on either surface, concolorous; panicle lax, deltoid; spikes dense, distichous, sessile or shortly peduncled, about ½ ft. long, 1¼ in. broad; lower branch-bracts with a long green lanceolate point; upper short, scarious, red; flower-bracts oblong-navicular, much imbricated, naked, stamineous, 1–1¼ in. long, ¾ in. broad, with a deltoid acute tip; calyx glabrous, as long as the flower-bracts; limb of the petal oblong, very small; stamens shorter than the petals.

Nearly allied to the Columbian *T. Kalbreyeri* Baker, Handb. Bromel. 28.

Espirito Santo, 1891 (1283). (Dr. Mez regards this as *T. paniculata* Ch. & Sch.)

HAEMODORACEAE.

Xiphidium floribundum Swz. Prod. Veg. Ind. Occ. 1: 17. Espirito Santo, 1891 (1280).

IRIDEAE.

Cypella Peruviana Baker, Bot. Mag. sub. *pl. 6213*. Vic. Cochabamba, 1891 (1157). Vic. Sorata, May, 1892 (1318) = Specimens by Pentland, not Mandon's 1223.

CYPELLA MANDONI sp. n.

Glabrous; bulb tunicated, ovoid-lanceolate, purple, conspicuously nerved; stems 1 m. or more high, very slender, purple at the base; leaves lightly sheathing, grass-like, about 1 cm. wide, strongly channelled, acute, exceeding the stem; peduncles axillary, stout, erect, 1–1.5 dm. long; spathes 2, ovate-lanceolate, acute, about 4 cm. long, 1 cm. wide, green, very finely many-nerved; bracts scarious, as broad as the spathes and slightly exceeding them; flowers 4 or 5, completely exserted, blue, nearly 3 cm. long, the triquetrous ovary 5 mm. long; capsule (immature) green, tipped with a short conical broad brown point.

Vic. Cochabamba, 1891 (1077). The same as Mandon's no. 1223, but not the same as Pentland's. In Herb. Kew. Mandon's specimen is doubtfully referred to *C. Peruviana*, but the width of leaves, size of spathe and color of flowers show that it is distinct.

Nemastylis nana Wats. Proc. Am. Acad. 18: 160. Near snow-line, Mt. Tunari, 1891 (1042) = Type in Herb. Kew., also (?) Mandon's 1224.

ORTHROSANTHUS NIGRORHYNCHUS sp. n.

Glabrous; rhizome stout, purple; basal leaves distichous, equitant, 3–4 dm. long, erect, rigid, linear, very narrow, acute; stems about 1 m. high, erect, slender, simple or branched; cauline leaves shorter than the stem, similar to the basal, long-sheathing; spathes racemose, the peduncles solitary in the axils of the upper leaves, shortly exserted; spathes 2, ovate, acute, 1.5 cm. long, enclosing one or more scarious bracts and a single sub-sessile white flower, which is 2.5 cm. long, the ovary 1 cm. long, black, oblanceolate, truncate; capsule lanceolate, truncate, the summit blackish.

Vic. Cochabamba, 1891 (1074).

Sisyrinchium junceum E. Meyer in Presl, Rel. Haenk. 1: 118. Vic. Cochabamba, 1891 (1075) = Mandon's 1222.

SISYRINCHIUM CRYPTOCARPUM sp. n.

Glabrous; stems densely tufted, the basal leaves, some longer, some shorter, than the stems, linear-terete, very slender, very acute; stems very slender, .75–1.5 or even 2 dm. high, terete; spathe green, setaceous, longer than the inflorescence, mostly 3-flowered, the flowers enclosed in scarious bracts with setaceous green awns, or the inner awnless; flowers not seen; capsule scarcely exserted, folded in the scarious bracts, black, obovoid, 4 or 5 mm. long.

Vic. Cochabamba, 1891 (1073). In the absence of flowers this is doubtfully referred to this genus, near *S. filifolius*. It is not impossible that it is an *Orthrosanthus*, which the inflorescence-habit more closely resembles. If so, it is quite distinct from any other species.

AMARYLLIDEAE.

Hippeastrum Mandoni Baker, Handb. Amaryll. 49. Vic. Sorata, Nov., 1892 (1624) = Rusby's 2454.

Bomarea distichyophylla (Herb.) Baker, Journ. Bot. 1882, 202. Between Tipuani and Guanai, Dec., 1892 (1722) = Rusby's 571 and 574.

VELLOZIA (XEROPHYTA) BOLIVIENSIS Baker, sp. n.

Stems short, slender, woody, covered downward with the persistent imbricated lanceolate bases of the old leaves; produced leaves many, crowded, narrow, linear, ascending, 6–9 in. long, tapering from a lanceolate base to a subulate tip, conduplicate, firm in texture, bristly and serrulate on the edges; peduncle shorter than the leaves, slender, 1-flowered, more or less bristly, especially upward; ovary subglobose, densely clothed with ascending bristles; segments lanceolate-conduplicate, an inch long,

bristly outside; stamens 6, shorter than the perianth-segments; anthers linear, nearly ½ in. long.

No other species of this genus is recorded from the Bolivian Andes, but there are a large number in the interior of Brazil and the rest are African.

Turedon, 1891 (1134).

DIOSCOREACEAE.

Dioscorea convolvulacea Ch. & Sch. Linnaea, 6: (1831) 49? Espirito Santo, 1891 (1296) = Fendler's 2171 and nearly his 1541.

Dioscarea —— in too young a state. Between Guanai and Tipuani, Apr.–June, 1892 (1379).

Dioscorea—species in all probability undescribed, but my material is insufficient for a description. Espirito Santo, 1891 (1264).

LILIACEAE.

ANTHERICUM SPRENGELI (*Phalangium ciliatum* Kunth, in H. & B. 1: 276 (1815) = *Anthericum ciliatum* Spreng. Syst. 2: 84 (1825), not L. f. Supp. (1781). A little below Cochabamba, 1891. (1061).

Nothoscordum flavescens Poepp. in Kunth, Enum, 4: (1843) 459 (*Allium f.* Poepp. Hort. Berol. 837). Below Cochabamba, 1891 (1060).

COMMELINACEAE.

Tradescantia elongata G. F. W. Meyer, Esseq. 146. Espirito Santo, 1891 (1282).

Campelia zanonia (L.) H.B.K. Nov. Gen. 1: 264. Between Guanai and Tipuani, Apr.–June, 1892 (1412) = Rusby's 1228 and 1229.

JUNCACEAE.

Juncus brunneus Buchen. (See no. 73). Below Cochabamba, 1891 (1076).

PALMAE.

Iriartea ventricosa Mart. Hist. Nat. Palm. 2: 37. *pl. 35, 36?* Between Tipuani and Guanai, Dec., 1892 (1734).

AROIDEAE.

Spathantheum Orbignyanum Schott, Bonplandia (1859) 165. Vic. Sorata, Nov., 1892 (1626). Determined by Mr. N. E. Brown.

CYPERACEAE.

(Determined by Prof. N. L. Britton.)

Cyperus vegetus Willd. Vic. Cochabamba, 1891 (1072).

Eleocharis sp. Too young for determination (1503).

Rynchospora paniculata Liebm. Vic. Cochabamba, 1891 (1071).

Rynchospora glauca Vahl. Between Guanai and Tipuani, Apr.–June, 1892 (1426).

GRAMINEAE.

(All of the numbers pertaining to this order will be published together in a later part of the enumeration).

MARSILEACEAE.

Azolla Caroliniana Willd. Near snow-line, Mt. Tunari, 1891 (1032 and 1033 mostly).

SELAGINELLACEAE.

Selaginella polycephala Baker. Espirito Santo, 1891 (1287).

Selaginella haematodes Spreng. Espirito Santo, 1891 (1286).

Selaginella microphylla Spreng. Vic. Cochabamba, 1891 (1097).

FILICES.

(Determined by Mrs. E. G. Britton.)

Hymenophyllum polyanthos Swz. Between Guanai and Tipuani, Apr.–June, 1892 (1384). Mixed with this is a species of *Lepidozia* and of *Bazzania*.

Adiantum obliquum Willd. Between Guanai and Tipuani, Apr.–June, 1892. (1449).

Pellaea marginata Baker. Vic. Cochabamba, 1891 (1094).

Pteris gigantea Willd. Vic. Tipuani, Dec., 1892 (1632).

Blechnum occidentale L. Vic. Guanai, July, 1892 (1594.)

Asplenium serratum. Between Guanai and Tipuani, Apr.–June, 1892 (1350).

Asplenium rhizophorum cicutarium Sw. (Specimen without number, locality or date) = Rusby's 389.

Polypodium serrulatum Mett. Between Guanai and Tipuani, Apr.–June, 1892 (1381).

Polypodium Plumula H.B.K. in a young state. Between Guanai and Tipuani, Apr.–June, 1892 (1448).

Polypodium angustifolium Swz. Espirito Santo, 1891 (1288).
Notholaena hypoleuca Kunze. Vic. Cochabamba, 1891 (1093a).
Platymiscium andinum Baker. Between Guanai and Tipuani, Apr.–June, 1892 (1414).
Aneimia phyllitidis Swz. Between Guanai and Tipuani, Apr.–June, 1892 (1351).
Aneimia trichorhiza Gardner? Vic. Cochabamba, 1891 (1093).
Lygodium venustum Swz Between Guanai and Tipuani, Apr.–June, 1892 (1349) = Rusby's 143.

MUSCI.

Polytrichum conforme Mitt. Mapiri, July–Aug., 1892 (1546).
Leucobryum giganteum C. Müll. Mapiri, July–Aug., 1892 (1505).

HEPATICAE.

(Determined by Prof. L. M. Underwood.)

Asterella sp.? Immature and not to be determined with certainty. Mapiri, July–Aug., 1892 (1545).
Aitonia valida. Vic. Mapiri, Jan., 1893 (1748).

LICHENES.

(Determined by Dr. J. W. Eckfeldt.)

Cladonia pyxidata (L.) Fr. Vic. Mapiri, Jan., 1893 (1762).
Cladonia gracilis verticillata Fr. Vic. Mapiri, Jan., 1893 (1763).
Cladonia botryella Nyl. Vic. Mapiri, Jan., 1893. (1761). *pp.*
Cladonia fimbriata (L.) Fr. (1761). *pp.*
Peltigera rufescens (Neck.) Hoffm. Vic. Mapiri, Jan., 1893 (1754, *pp.*; downy above).
Peltigera canina membranacea (Ach.) Nyl. Vic. Mapiri, Jan., 1893 (1754 *pp.*; smooth throughout and more or less fibrillose beneath).
Parmelia citrata Ach. Vic. Mapiri, Jan., 1893 (1750). *pp.*
P. praetervira Muell, Arg. Vic: Mapiri, Jan., 1893 (1750). *pp*
Theloschistes chrysophthalmus (L.) Norm. Vic. Sorata, May, 1892 (1316a).
Theloschistes chrysophthalmus flavicans Wall. Vic. Mapiri, Jan., 1893 (1755).

Usnea barbata florida Fr. Vic. Mapiri, Jan., 1893 (1749).
Sticta pallida Hook. Vic. Mapiri, Jan., 1893 (1756).
Sticta quercizans Peruviana? Vic. Mapiri, Jan., 1893 (1751 *pp.*).
Sticta (*Ricasolia*) *corrosa* Sch. Vic. Mapiri, Jan., 1893 (1760).
Leptogium pulchellum (Ach.) Nyl. Vic. Mapiri, Jan., 1893 (1753).
LEPTOGIUM PHYLLOCARPUM (Pers.) Eckfeldt (*L. bullatum phyllocarpum* Pers.) Vic. Mapiri, Jan., 1893 (1752).
Cora pavonia Fr. Vic. Mapiri, Jan., 1893 (1759).
Physcia leucomella (L.) Michx. Vic. Mapiri, Jan., 1893 (1751).
Physcia hypoleuca (Mühl) Tuck. Vic. Mapiri, Jan., 1893 (1757).
The same covered with *Biatora* (*Abrothallus*) *oxyspora* (Nyl.) Tul. Vic. Mapiri, Jan., 1893 (1758).

FUNGI.

(Determined by Prof. W. G. Farlow.)

Hexagonia tenuis Hook. Between Guanai and Tipuani, Apr.–June, 1892 (1327).
Polyporus Floridanus Berk. Between Guanai and Tipuani, Apr.–June, 1892 (1325).
Polyporus sanguineus Fr. Between Guanai and Tipuani, Apr.–June, 1892 (1323).
Lenzites striata Fr. Between Guanai and Tipuani, Apr.–June, 1892 (1322, *pp.*).
Polystictus flavidus Berk. Between Guanai and Tipuani, Apr.–June, 1892 (1322, *pp.*).
Polystictus occidentalis (Klotsch) Fr. Between Guanai and Tipuani, Apr.–June, 1892 (1324). The form which has been called *P. byrsimus* Mont.
Hypolyssus Montagnei Berk. Mapiri, July–Aug., 1892 (1479).
Dimerosporum sp. Mapiri, July–Aug., 1892 (1547).
Agaricini, not in a condition to be determined, are nos. 1326, 1447 1498, 1747, 1765 and 1769.
No. 1570 is an indeterminable mixture of fresh-water algae.
Nos. 994, 1540, 1542, 1764, 1766, 1767 and 1768 are galls.

MEMOIRS

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A Revision of the North American Isotheciaceae and Brachythecia.

By ABEL JOEL GROUT.

The work on the Isotheciaceae and Brachytheciaceae was undertaken with the purpose of correlating and bringing up to date the later work on the American plants of this group which has been done largely by foreigners and has been published in various scientific publications, some of which are difficult of access. Barnes and Heald's new Keys to the Genera and Species, it is true, contain all these collected descriptions, but it has been felt by every student of American bryology that much of the recent work, especially that of Nils Conrad Kindberg, was, to say the least, of uncertain value. The sentiments expressed by Dr. Barnes concerning this matter in the preface to the second edition of his Keys, are heartily approved by every American bryologist. A very large proportion of the new species in this group has been founded on insufficient and incomplete material and the descriptions of perfect specimens even have often been entirely inadequate for the determination of the species.

My thanks are especially due to Professor John Macoun, Dr. William Mitten and M. Jules Cardot for notes and specimens. By Professor Macoun's kindness I have been able to examine type collections of most of Kindberg's new species. Professor Macoun assures me that the specimens of *Brachythecium harpidioides*, *B. lamprochryseum*, *B. gemmascens*, *B. rutabuliforme*, *B. pseudo-collinum*, *B. nanopes*, *B. platycladum* and *B. mirabundum* "are absolutely identical with those named by Kindberg."

The work was undertaken at the suggestion of Mrs. Elizabeth G. Britton, to whose kind criticism and assistance is due much of whatever value this revision may possess. These studies were begun about the time that Limpricht's treatise on the Isotheciaceae (Rabenhorst Kryptogamen Flora) was issued and it was planned to parallel his work on the European plants of this and related groups by a somewhat similar treatment of the American forms.

Except the recent issue of the first part of Braithwaite's work on the pleurocarpous mosses, all the extended treatments of the Musci Pleurocarpi have followed Schimper's classification in principle.

A somewhat fragmentary publication like this has followed the more extended treatises in this particular by reason of the comparatively narrow limits of the work.

This study was begun with no bias either for or against Schimper's classification, but, as the work progressed, it became more and more evident that the Isotheciaceae do not form a natural group, but a highly artificial one, being based principally on the following characters: Erect capsule, inner peristome attached to a narrow basal membrane, and absence of cilia.

It is very easy to see that the cilia, being merely thickenings of cell walls, would be much more likely to disappear wholly or partially as a variation than that the variation should modify the general structure of the plant and leaf. In some plants the number of cilia varies from one perfect cilium and another imperfect to three perfect cilia. In *Brachythecium Fendleri*, which is described as having cilia solitary and short or none, other capsules from type specimens possess two well developed cilia. In species where cilia have never been known to develop, the lack of cilia is of greater import, but even when associated with an erect capsule cannot be considered as a character suitable to distinguish families, although these characters may well distinguish species or even genera, their importance depending solely on their constancy.

Any one who will take the trouble to compare carefully the European species of *Homalothecium* with several species of *Camptothecium* cannot help seeing that the two genera are much more closely related than *Homalothecium* and *Entodon*, or any genera of he Isotheciaceae.

The species of *Pylaisiella* also are so closely related to *Hypnum* (*Raphidostegium*) *cylindricarpum* Muell. that Jaeger (St. Gall. Nat. Gesell. 1876–77: 304) calls the latter a *Pylaisia*. *Hypnum cylindricarpum*, notwithstanding, is not a unique species in this respect, but is very closely related to several other species, notably *H. microcarpum* Muell. *Entodon* is also more closely allied to *Plagiothecium* than to any of the other Isotheciaceae.

All the species of *Isothecium* itself excepting, perhaps, *I. myurum* are so closely related to *Brachythecium* and other genera of the Brachytheciaceae that there is no reason whatever for putting them in another family. These conclusions were arrived at independently, but a comparison with Lindberg's Musci Scandinavici will show that this is essentially his idea of the relations of the species, although he combines the genera to an extent not likely to be approved by succeeding workers.

These facts have led to the conclusion that, in the Hypnaceae at least, Lindberg's general classification must be conceded to be much more natural than that of Schimper. In order to present the result of two years' labor in a form available for immediate use, the generally accepted classification has necessarily been followed in part, but care has been taken to arrange the species in genera in a way that will not require any change in order to conform to the general principles of Lindberg's classification.

A great deal of attention has been given to ascertaining the habitat and distribution of the species, as data of this kind have proved of the greatest value in deducing those general principles of biology which represent the highest achievements of science and to which the systematist, the physiologist, and the morphologist alike contribute.

In this connection it is worthy of remark that very few collectors give sufficient data on their labels. It is to be hoped that the collectors of the future will record the exact habitat of each collection and time at which the collection was made as well as locality and year. Had these data been given with each specimen studied in the preparation of this revision, the work would have been much simplified and its value greatly enhanced. The aim of the work has been to render intelligible the species already de-

scribed rather than to complicate the matter by making a new species of every doubtful specimen at hand. Doubtless a more complete knowledge of our moss-flora will show that many forms described as varieties will prove to be good species.

The keys are entirely new and have been made with special reference to their use by amateurs. Gametophyte characters have been used in preference to sporophyte characters wherever possible, in order to facilitate the identification of sterile specimens.

Special care has been taken to correlate the descriptions so that any character of two closely related species can be easily compared. Measurements, both comparative and absolute, have been given in order to facilitate such comparisons.

The absence of many published varieties will be noticed and probably criticized. The extreme multiplication of varieties, so much in vogue with the Germans, seems to the author to be confusing and valueless. Only well marked varieties, with characters easily recognizable, have been included. Often these would seem to be good species except for the many intermediate forms. In other cases more material will probably give characters sufficient to raise the varieties to specific rank.

ISOTHECIACEAE Spruce, Ann. and Mag. Nat. Hist. (II.) 3: 285. 1849.

Gametophyte generally large, never minute. Primary stems creeping, radiculose. Paraphyllia lacking (except in *Climacium*). Leaves smooth, often plicate or concave; median leaf-cells linear, alar cells quadrate (except in *Holmgrenia*). *Sporophyte* long exserted. Seta smooth, twisted. Calyptra cucullate. Operculum conic to conic-rostrate. Columella persistent. Capsule erect, straight, not conspicuously contracted under the mouth when dry. Peristome double, well developed; teeth lanceolate, articulate. Segments of endostome linear to lanceolate, attached to a narrow basal membrane, free, or adherent to the teeth in two species of *Pylaisiella*; cilia rudimentary or wanting. Spores roughened.

Distinguished from the Brachytheciaceae by the straight erect capsule not contracted under the mouth when dry, absence of cilia and short basal membrane.

Homalothecium and certain species of *Brachythecium* (notably *B. acuminatum*) have the capsule characters of this family, but their other characters show their relationship to be with the Brachytheciaceae.

Key to the Genera.

Leaves costate, costa single, extending to the middle of the leaf or beyond. 4. CLIMACIUM.

Leaves ecostate or the costa short and double.

Alar cells not quadrate. 3. HOLMGRENIA.

Alar cells quadrate.

Leaves complanate (except *E. repens* and *E. seductrix*); annulus large, persistent (except *E. Drummondii*). 1. ENTODON.

Leaves more or less falcate-secund especially at the tips of branches; annulus narrow. 2. PYLAISIELLA.

1. ENTODON C. Muell. Linnaea, 18: 704. 1844. Also Bot. Zeit. 2: 740. 1844.

[CYLINDROTHECIUM Br. & Sch. Bryol. Eur. fasc. 46, 47. *pl. 464, 465.* 1851.]

Gametophyte growing in wide intricate mats. Stems densely leafy, creeping, subpinnately branching (stems erect and pinnate in *E. orthocarpus*); stem and branches more or less complanate-

foliate, not radiculose above, without paraphyllia. Leaves pluriseriate, imbricate, entire or slightly serrate at apex, smooth, concave, ecostate or with a very short double costa; leaf-cells linear, enlarged and quadrate at the basal angles. Male branches gemmiform, borne on the stem. *Sporophyte* with the seta long, smooth, twisted to the right. Calyptra cucullate. Capsule cylindric, erect and symmetric or sometimes slightly curved. Operculum conic to conic-rostrate. Columella persistent. Annulus large and conspicuous (aborted and indistinct in *E. Drummondii*), remaining attached after dehiscence and falling away in fragments with age. Peristome double, inserted below the mouth of the capsule; teeth subulate to linear-lanceolate, strongly articulate; segments narrowly linear, carinate, attached to a very narrow basal membrane (usually free in *E. repens;* attached to teeth as a hyaline margin in *E. brevisetum*). Spores brown to brownish green, minutely roughened.

The leaves of many species of this genus are much more variable than the peristome, consequently the distinctions are based upon peristome characters wherever possible.

Leaves obtuse; quadrate alar cells in 2 or 3 layers. 7. *E. orthocarpus.*
Leaves acute or acuminate; quadrate alar cells in one layer.
  Leaves gradually narrowly acuminate; segments of endostome adhering to the teeth. 8. *E. brevisetus.*
  Leaves acute to apiculate; segments free.
    Teeth conspicuously hyaline margined. 6. *E. repens.*
    Teeth not conspicuously hyaline margined.
      Annulus apparently none; seta yellow. 5. *E. Drummondii.*
      Annulus narrow, of small cells; seta red. 2. *E. seductrix.*
      Annulus large, of large cells.
        Teeth uniformly papillose-roughened. 3. *E. compressus.*
        Teeth conspicuously striolate above; leaves serrate. 4. *E. Sullivantii.*
        Teeth not conspicuously striolate; leaves nearly entire. 1. *E. cladorrhizans.*

1. ENTODON CLADORRHIZANS (Hedw.) C. Muell. Linnaea, **18**: 707. 1844. Also Bot. Zeit. 1844.

Neckera cladorrhizans Hedw. Sp. Musc. 207. *pl. 47.* 1801.
Cylindrothecium cladorrhizans Schimp. Syn. Ed. 1, 514. 1860.
Entodon Transylvanicus Demet. Hedwigia, **23**: 81. 1884.
Entodon minutipes Kindb. Can. Rec. Sci. **1894**: 21. 1894.

Gametophyte in wide soft glossy yellowish-green intricate mats; stems about 5 cm. long, subpinnately branching; stems and short branches complanate-foliate, lying in the same plane; older branches often radiculose at end; branch leaves oblong-ovate, 1.5 by 0.6–0.8 mm., acute, entire or slightly denticulate at apex, very concave; costa short and double; median cells linear fusiform, 10–15 : 1; quadrate alar cells numerous; stem leaves larger and broader at base: monoicous; male branches frequent; antheridia few, large, cylindric; perigonial leaves sub-orbicular to oval, short acuminate, entire, ecostate: perichaetium 2.5 mm. long, loosely sheathing; the inner leaves oblong-acuminate, denticulate at extreme apex; upper cells linear; basal enlarged, hyaline, rhomboidal to rectangular. *Sporophyte* 1.5 to 2.5 cm. high; seta light reddish brown; capsule cylindric-ovoid, brown, 3.5 mm. long, 5–6:1; annulus large, of two rows of cells; peristome about .35–.4 mm. long; teeth linear-lanceolate, reddish brown, closely and regularly articulate and slightly granulose-roughened below, lighter, more distantly articulate and smooth or finely striolate above, with conspicuous median line, often perforate between articulations; segments linear, as long as the teeth; spores minutely roughened, 16μ, maturing in autumn.

Type locality, Lancaster, Pa. (Muhlenberg).

On roots of trees, old logs, soil, etc. Not uncommon in North America east of the Mississippi; Minnesota (Holzinger); Iowa (A. S. Hitchcock and Miss McGee).

ILLUSTRATIONS.—Sull. Icon. Musc. *pl. 91;* Hedw. l. c.; A. Gray, Man. Ed. 2, *pl. 5*; Lesq. & James, Mosses of N. A. *pl. 5*; Husnot, Musc. Gall. *pl. 89*; Rab. Krypt. Fl. 4^3: *f. 356.*

EXSICCATI.—Drumm. Musc. Am. (S. States) 96, (*Neckera cladorrhizans*); Sull. Musc. Allegh. 77; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 260, (Ed. 2) 386. Macoun, Can. Musc. 263.

Limpricht, in Rab. Krypt. Fl. 4: part 3: 30, separates *E. Schleicheri* of Europe from *E. cladorrhizans* and also cites *E. cladorrhizans* as European. That the two species are distinct can hardly be doubted, if the teeth of the peristome be compared. *E. acicularis* C. Muell. and Kindb. in Macoun, Cat. Can. Pl. part 6, 176 (Macoun's 816 in part and 170), is only a peculiar form of *E. cladorrhizans.* It may possibly prove to be a good variety.

It is characterized by having a peculiar brownish green color, the tips of branches lighter; very short turgid branches which are largest in the middle and at the largest part bear leaves as large as the stem leaves; capsule and seta much shorter and teeth more perforate than is typical. *E. Transylvanicus* Demeter and *E. minutipes* Kindb. are said by Limpricht, l. c. to be identical, and only slightly divergent forms of *E. cladorrhizans*. I have been unable to see specimens of either.

2. ENTODON SEDUCTRIX (Hedw.) C. Muell. Linnaea, 19: 214. 1847.

Neckera seductrix Hedw. Sp. Musc. 208. *pl. 47. f. 8–13.* 1801.

Pterigynandrum Carolinianum Brid. Musc. Recent. Suppl. 1: 132. 1803.

Cylindrothecium seductrix Sull. in A. Gray, Man. Ed. 2, 664. 1856.

Gametophyte in wide glossy yellowish-green mats; stems about 5 cm. long, more or less complanate-foliate; branches nearly terete, 5–10 mm. long, often giving off short secondary branches; branch leaves imbricate-appressed, oblong-elliptical to ovate, about 1.2 by 0.7 mm., short-apiculate, entire or slightly denticulate above; costa short and double, median cells linear; quadrate alar cells numerous; stem leaves ovate, larger, with rather broader cells; monoicous; male branches abundant, short-stipitate; antheridia comparatively few, large, oblong; perigonial leaves obovate, apiculate, entire, bordered with a row of narrow cells, ecostate; paraphyses large: perichaetium about 2.5 mm. long, loosely sheathing; the inner leaves oblong-acuminate, serrulate at apex, somewhat plicate with a thin costa extending to the middle. *Sporophyte* 1.3–1.6 cm. high; capsule reddish brown, cylindric, 3–3.5 mm. long, 5–6: 1; operculum conic-rostrate; annulus of two to three rows of small cells, obscured by base of teeth; teeth of peristome subulate, short, 0.3 mm. long, very deeply inserted, about $\frac{1}{6}$ below the mouth of capsule, dark reddish brown below, much lighter above, bordered by a lighter margin, with a very distinct median line throughout the entire length; articulations close and irregular below but distant above, only 7 to 10 appearing above the mouth of capsule; segments linear, about the length of

the teeth; spores about 15μ, finely roughened, time of maturing variable, probably depending on season, autumn to early winter.

Type locality, Lancaster, Penn. (Muhlenberg).

On decaying wood, earth, moist rocks, bark of trees, etc.

A very variable species and appropriately named; found only in the eastern United States and Canada. Common in the Appalachian region from Canada to the Gulf; less frequent northward and not reported far west of the Mississippi. I have seen no specimens from northern New England or eastern Canada.

Dallas, Texas (J. Boll); Missouri, Kansas, Wisconsin, Minnesota, Ontario.

ILLUSTRATIONS.—Hedw. l. c.; Sull. Icon. Musc. *pl. 92*.

EXSICCATI.—Drumm. Musc. Am. (S. States) 97, (*Neckera seductrix*); Sull. Musc. Allegh. 78; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 261, (Ed. 2) 387; Macoun, Can. Musc. 663; Ren. & Card. Musc. Am. Sept. Exsic. 90.

2a. E. SEDUCTRIX LANCEOLATUS Grout, Bull. Torr. Club, **23**: 226. 1896.

Stem leaves ovate-lanceolate, acute; branch leaves broadly lanceolate, tapering gradually to the serrate acute apex; median cells 12 : 1; capsule 3–5 mm. long, about 8 : 1.

On rotten wood, Hanging Rock, Wabash Co., Ill., April 3, 1890. (J. Schneck.)

2b. E. SEDUCTRIX MINOR (Aust.) Grout, l. c.

Entire plant much reduced, dirty green; leaves, seta and capsule shorter than in type. Capsules 1.5–2 mm. long, its length about 3 times its diameter.

Ohio (Sullivant); sand hill near Augusta, Ga. (J. D. Smith), Feb. 2, 1877. A portion of no. 388 of Sull. and Lesq. Musc. Bor. Am., in Columbia Herb., issued as *Cylindrothecium compressum* Br. and Sch. is this variety.

2c. E. SEDUCTRIX DEMETRII (Ren. & Card.) Grout, l. c.

Cylindrothecium Demetrii Ren. & Card. Rev. Bryol. **20**: 14. 1893.

Stems irregularly divided and branched, strongly complanate-foliate, slender, having almost exactly the facies of *E. compressus;*

leaves ovate, gradually acute, very entire. Peristomal teeth often irregularly perforate.

On stones at top of well, Emma, Saline Co., Mo. (Rev. C. H. Demetrio).

This species is easily distinguished from *E. cladorrhizans* by its short deeply inserted sparsely articulate peristomal teeth, peculiar annulus, and by its dark and less flattened stem and branches. It is exceedingly variable and the three varieties named above are the most aberrant forms. Judging from the figures, Hedwig's type differs a good deal from the plant figured by Sullivant; it has ovate leaves and rather short capsules while Sullivant figures an elliptical-oblong leaf and a much larger capsule. The plants corresponding to Hedwig's figure grow in places that are dry at times, and its leaves are regularly and closely imbricated on the stout, terete branches. The regularity of imbrication gives a very striking appearance like the shingles of a roof. The plants corresponding to Sullivant's figure grow on rotten wood and in more moist situations; the branches are more slender, the leaves less abruptly apiculate and less closely and regularly imbricate. Sullivant's figure, l. c., of the mouth of the capsule is incorrect; he figures the mouth of the capsule as it appears when first mounted in water, but when cleared up with glycerine it will be seen that 2 or 3 of the upper rows of cells are small annulus cells. Var. *lanceolatus* is characterized principally by its lanceolate leaves and var. *minor* by its short capsules, var. *Demetrii* by its strongly flattened stems and branches.

3. ENTODON COMPRESSUS (Hedw.) C. Muell. Linnaea, **18**: 707. 1844.

Leskea compressa Hedw. Sp. Musc. 232. *pl. 56. f. 1–7.* 1801.

Cylindrothecium compressum Br. & Sch. Bryol. Eur. fasc. 46–47. 1851.

Gametophyte in thin dirty green mats; stem and branches complanate-foliate and lying in the same plane, as in *E. cladorrhizans*, but both much more slender; stems often much divided, 2–5 cm. long, subpinnately branching; branches short; leaves becoming appressed in drying, causing the plants to lose their flattened appearance in a measure; branch leaves oblong-ovate, 1.1 mm. long by half as wide, obtuse, with apiculation very short or none, entire or slightly denticulate at apex, very concave; costa short and double; median leaf cells linear, 11: 1; basal cells quad-

rate; stem leaves larger, proportionately broader, entire: monoicous; male branches small; antheridia few, subcylindric; inner perigonial leaves ovate, acute, ecostate, bordered by a row of narrow cells: perichaetium 1.5–2 mm. long, sheathing; inner leaves oblong-lanceolate, very gradually acuminate, entire, slightly bicostate; leaf cells linear above, rhomboidal below. *Sporophyte* 12–15 mm. high; seta light reddish-brown; capsule brown, elongated-ovoid, contracted below mouth, 2.5 mm. long, 4: 1; operculum conic-rostrate, with a slender inclined beak; annulus compound, persistent, of 3 rows of cells; peristome about 0.3–0.4 mm. long; teeth narrowly linear-lanceolate, closely and regularly articulate, densely and minutely papillose; segments linear, shorter than the teeth, usually broken off, minutely papillose; spores very minutely roughened, 11–13μ, maturing in autumn.

Type locality, Lancaster, Penn. (Muhlenberg).

On earth and rotten logs in the shade, roots of trees near water courses.

Rhode Island, New Jersey, Ohio, Illinois, Kansas, Nebraska, Missouri. Not common.

ILLUSTRATIONS.—Hedw. l. c.; Sull. Icon. Musc. *pl. 93.*

EXSICCATI.—Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 264, (Ed. 2) 388 in part, mixed with *E. seductrix minor.*

Easily distinguished by its short ovoid capsules and long minutely papillose peristome.

4. ENTODON SULLIVANTII C. Muell. Can. Rec. Sci. **1894**: 21. 1894.

Neckera Sullivantii C. Muell. Syn. Musc. **2**: 65. 1851.

Cylindrothecium Sullivantii Sull. in A. Gray, Man. Ed. 2: 664. 1856. Also Icon. Musc. 149. *pl. 95.*

Gametophyte in rather thin, glossy-green mats; stems 3–5 cm. long, pinnately branching; stem and branches slender, complanate-foliate, lying in the same plane; branches 5–15 mm. long; branch leaves ovate-lanceolate, 1.1 by 0.4 mm., acute, serrate at apex, very concave, margins incurved; costa short and double; median cells linear-rhomboidal, 8:1; quadrate alar cells numerous, extending nearly or quite to costa at base; stem leaves much larger, 1.6 mm. long, broadly ovate-lanceolate, entire except at ex-

treme apex: male branches elongated-ovoid; perigonial leaves oval-oblong, concave, with a short broad acumination: perichaetium 1.5–2 mm. long; inner leaves erect, loosely sheathing, oval-oblong, acuminate, entire or serrulate at apex, ecostate, leaf-cells of upper half linear-rhomboidal, gradually much broader and looser below. *Sporophyte* 1.8–2.5 cm. high; seta orange; capsule brown, cylindric, 3.5–4 mm. long, 5–7 : 1; operculum conic-rostrate; annulus very large, compound, of 3–4 rows of cells; peristome nearly 0.4 mm. long; teeth linear-lanceolate, orange, closely and regularly articulate; upper part of teeth with articulations more distant, marked with a double line, irregularly striolate with striolae vertical to oblique; obscurely striolate below with horizontal striolae; segments a little shorter than teeth, linear from a lanceolate base; spores minutely roughened, about 13μ.

Type locality in woods along the French Broad River, N. Carolina (Sullivant).

On damp rocks in woods.

North Carolina (Gray and Sullivant); Tennessee (Lesquereux); South Carolina. Very rare.

Reported from Japan. *Vide* Jaeger, Adumbratio.

ILLUSTRATIONS.—Sull. l. c.

EXSICCATI.-Sull. Musc. Allegh. 64, (*Leskea compressa*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 263, (Ed. 2) 389.

Easily distinguished from *E. compressus*, which it resembles, by its more slender stem and branches, serrate leaves, longer capsule, and striolate teeth.

5. ENTODON DRUMMONDII (Br. & Sch.) Jaeger & Sauerb. Ber. St. Gall. Nat. Gesell. 1876–77 : 282.

Cylindrothecium Drummondii Br. & Sch. Bryol. Eur. fasc 46–47. 1851.

Neckera cladorrhizans Hook. & Wils. Drumm. Musc. Am. (S. States) 96. 1841.

Gametophyte in rather thin yellowish green mats; stems 4–8 cm. long, complanate-foliate, subpinnately branched; branches lying in one plane, short; branch leaves loosely imbricate, oblong-lanceolate to ovate-lanceolate, 1.8 by 0.5–0.7 mm., acute, serrate at apex, smooth, concave, ecostate; upper cells linear, 15:1; basal

enlarged, rhomboidal, quadrate at the angles; stem leaves shorter and broader with more enlarged and hyaline basal cells: monoicous; male branches borne on stem or branches; antheridia oblong; paraphyses numerous and large; perigonial leaves oval to short-oblong, concave, the inner with a short, broad acumination: perichaetium about 2.5 mm. long; outer leaves sheathing at base with tips more or less spreading; inner nearly erect, oblong, long acuminate with a few long spreading teeth at apex; leaf-cells linear above, gradually enlarged to rhomboidal or quadrate at base. *Sporophyte* 10–25 mm. high; seta yellow; capsule brown, cylindric, 2–2.5 mm. long, 4:1; operculum long-conic, apiculate; mouth of capsule bordered by two or three rows of horizontally compressed cells, above these a row of enlarged cells without a cavity, closely simulating non-vesicular annulus cells; peristome about 2.5 mm. long; teeth linear-lanceolate, smooth and hyaline above, striolate and often thicker, brown and perforate below; segments linear, nearly or quite as long as teeth; spores minutely roughened, 13–15 μ, apparently maturing in spring, but data insufficient.

Type locality, Louisiana (Drummond).

On trees, rocks and logs, in woods. Southern United States east of the Mississippi, north to Tennessee and North Carolina; northern Mexico (Pringle).

ILLUSTRATIONS.—Sull. Icon. Musc., *pl. 94.*

EXSICCATI.—Drumm. Musc. Am. (S. States) 96 type; Sull. & Lesq. (Ed. 1) 264, (Ed. 2) 390. Aust. Musc. Appal. Suppl. 538; Ren. & Card. Musc. Am. Sept. Exsic. 91. Macoun's Can. Musc. 436 is not this species.

Distinguished at sight from *E. cladorrhizans* and *E. compressus* by its very wide flattened branches and yellow seta.

6. ENTODON REPENS (Brid.) Grout, Bull. Torr. Club, **23**: 227. 1896.

Pterigynandrum repens Brid. Musc. Recent. Suppl. 1: 131. 1806.

Platygyrium repens Br. & Sch. Bryol. Eur. fasc. 46–47. *pl. 458.* 1851.

Pterogonium repens Schwaegr. Suppl. 1^1: 100. *pl. 27.* 1811.
Neckera repens Schwaegr. Suppl. 3^1: Sect. 2. *pl. 246.* 1828.
Cylindrothecium repens De Not. Epil. 214. 1869.

Gametophyte in rather thin intricate mats, varying from dark green to a lighter yellowish green; stems 2–6 cm. long, prostrate; branches short, cylindric, ascending, often slightly curved; ends of sterile branches often bearing numerous small gemmae in the axils of the leaves; leaves oblong-ovate to oblong-lanceolate, closely imbricate when dry, 0.7–1.2 mm. long by 0.3–0.4 mm. wide, acute to acuminate; margins recurved and entire; costa lacking or short and double in robust plants; apical cells rhomboidal, median linear, 8 : 1; quadrate alar cells numerous and extending up the margin of leaf; stem leaves larger and proportionally broader: dioicous; male branches not abundant; antheridia oblong, large, stipitate; perigonial leaves bordered by a row of narrow cells, short-oblong, concave, slightly narrowed at base: perichaetium 1.5 mm. long, sheathing below, spreading above; inner leaves oblong, long acuminate, denticulate at apex, usually with a short thin double costa, upper cells linear, alar enlarged and rectangular. *Sporophyte* 2–3 cm. high; seta brown; capsule erect, about 3 mm. long, 4 : 1, brown; operculum conic-rostrate; annulus large, of three rows of cells; peristome 3–4 mm. long; teeth linear-lanceolate, hyaline-margined, orange, with raised lines at base; segments linear, usually free at base, nearly as long as teeth; spores minutely roughened, 14μ, maturing in early autumn.

Type locality, Switzerland.

On bark of trees, decaying logs and stumps. Europe, and North America east of the Rocky Mountains. Common.

Illustrations.—Schwaegr. l. c.; Br. & Sch. l. c.; Lesq. & James, Mosses of N. A. *pl. 5.*; Husnot, Musc. Gall *pl. 89.*; Limpr. Rab. Krypt. Fl. 4^3: *f. 353.*

Exsiccati.—Drumm. Musc. Am. (S. States) 98 and Musc. Am. 159 (*Neckera sericea*). Sull. Musc. Allegh. 45; (*Neckera sericea*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 259, (Ed. 2) 385; Austin, Musc. Appal. 281; Ren. & Card. Musc. Am. Sept. Exsic. 235.

6a. ENTODON REPENS ORTHOCLADOS (Kindb.) Grout, Bull. Torr. Club, 23: 227. 1896.

Platygyrium repens orthoclados Kindb. in Macoun, Cat. Can. Pl. 6: 172. 1892.

Platygyrium repens sciuroides Limpr. Rab. Krypt. Fl. 4^3: 7. 1896.

Platygyrium repens ramulis elongatis Bryol. Eur. *pl. 458. f. 3.*

Glossy, yellowish green. Branches much larger and longer; leaves larger, 1.2×0.4 mm., loosely imbricate, shortly bicostate.

Type from Skeads' Farm near Ottawa (Macoun).

EXSICCATI.—Sauter in Breut. Musc. Frond. Exsic. 296; Macoun, Can. Musc. 259 in part.

This variety seems to me to be only a robust form of a variable species. It was not considered by Schimper as worthy of varietal rank, although he figures the form. I have seen Dr. Sauter's type and also Kindberg's and they are without doubt the same. Kindberg's criticisms in Macoun's Catalogue on the descriptions and plates of this species are entirely without point. The Columbia College specimens of Macoun's no. 259 contained no fragment of *Platygyrium*, but consisted of *Pylaisia polyantha*.

Every character that has been supposed to separate this species from the genus *Entodon*, is possessed by some other member of the genus as here constituted, hence, in spite of its unlike appearance it seems best to place it here.

7. ENTODON ORTHOCARPUS (La Pyl.) Lindb. Musc. Scand. 39. 1879.

Hypnum Schreberi orthocarpum Brid. Bryol. Univ. 2: 422. 1827.

Hypnum orthocarpum La Pylaie; Brid. Bryol. Univ. 2: 422. 1827.

Cylindrothecium Montagnei Br. & Sch. Bryol. Eur. fasc. 46–47, *pl. 465.* 1851.

Cylindrothecium concinnum Schimp. Syn. 515. 1860.

Gametophyte in wide loosely intricate yellowish green tufts; stems 2–10 cm. or more long, suberect, pinnately branching; stems and branches terete to somewhat complanate-foliate, rigid; branches about 1 cm. long, tapering; branch leaves oval-oblong, 1.2×0.6 mm. obtuse, entire, very concave, with involute margins, ecostate or short bicostate; upper cells fusiform, much shorter and

broader at apex, median about 10:1, basal strongly porose; quadrate alar cells numerous, small, extending up the margin of leaf, densely chlorophyllose, 2–3 layered in the central alar area; stem leaves larger and broader cells narrower and longer: dioicous; perigonial leaves oval, obtusely acuminate, ecostate; antheridia large, inflated: perichaetium about 2 mm. long, loosely sheathing; the inner leaves large, oblong, gradually narrowed above, obtusely acute, entire; median leaf-cells linear, lower rhomboidal. *Sporophyte* 2–2.5 cm. high; seta dark red-brown; calyptra dimidiate, long, descending to below the base of capsule; capsule brown, erect, cylindric, 3 mm. long, 5:1; operculum conic-rostrate, beak often oblique; annulus of 2–3 rows of small cells; peristome about 0.3–0.5 mm. long; teeth linear-lanceolate, red-brown, and closely articulate below, orange and distinctly articulate above, with a very distinct median line along which the tooth is often perforate or split; segments linear, as long as the teeth or longer; "basal membrane none;" spores minutely roughened, about 15μ, maturing in autumn.

Type locality, France (La Pylaie).

Very rare and sterile. Colorado (Brandegee). Middle Arm, Newfoundland (Rev. A. C. Waghorne).

ILLUSTRATIONS.—Br. & Sch. l. c.; Husnot, Musc. Gall. *pl. 89.*

This species is quite common in Europe, but mostly sterile. It has been collected only twice in America. The American specimens in the Columbia herbarium are all sterile and I suspect that all of Brandegee's and Waghorne's collection lacked fruit. The fruit is described from a European specimen.

8. ENTODON BREVISETUS (Hook. & Wils.) Jaeger & Sauerb. Ber. St. Gall. Nat. Gesell. 1876–77: 291.

Neckera breviseta Hook. & Wils. Lond. Jour. Bot. 4: 419. *pl. 24 f. a.* 1842.

Cylindrothecium brevisetum Br. & Sch. Bryol. Eur. fasc. 46–47. 1851.

Gametophyte in wide densely intricate mats, dark green below, tips of short branches lighter; stems varying greatly in length, averaging about 5 cm., creeping, subpinnately branching; branches short, suberect, abruptly tapering at end, lower often radicu-

lose at tip; leaves closely imbricate when dry; branch leaves lanceolate, 1.9×0.6 mm., gradually narrowly acuminate, entire or slightly serrulate at apex, concave; costa double, extending nearly ¼ length of leaf; median cells oblong-hexagonal with length 6 times diameter; alar and basal cells quadrate, chlorophyllose; stem leaves larger, ovate-lanceolate: monoicous; male branches frequent; antheridia numerous, oblong-ovoid, stipitate; perigonial leaves bordered by a row of elongated cells, inner oblong-obovate, short acuminate: perichaetium 3.5 mm. long; the outer leaves sheathing at the base with squarrose tips; the inner erect, oblong-lanceolate, long acuminate, entire; costa double, ending below the middle; leaf-cells linear above, rhomboidal below. *Sporophyte* 10–20 mm. high; seta light reddish brown; capsule brown, 2.5–3 mm. long, 5 : 1, cylindric-ovoid, contracted below the mouth when dry; operculum long-conic, obtuse; annulus compound, of 3 rows of cells; peristome 0.3 mm. long; teeth linear-lanceolate, reddish brown, closely and regularly articulate, nodulose at articulations above, bordered the entire length by the adherent segments; spores tuberculate, 21 μ, maturing in autumn.

Type locality, Missouri, near St. Louis (Drummond).

On trees, limestone rocks, etc., New Jersey, Virginia, Pennsylvania, Ohio, Missouri; Canaan Forks, New Brunswick (J. Moser). Not common.

ILLUSTRATIONS.—Hook. & Wils. l. c.; Sull. Icon. Musc. *pl. 96.*

EXSICCATI.—Drumm. Musc. Am. (S. States) 95, (Type); Sull. Musc. Allegh. 79; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 265, (Ed. 2) 391.

This species is readily distinguished from all others by its narrowly acuminate leaves and the adherent segments of the inner peristome. The locality given in the Manual of Lesq. & James must be a mistake, as I have been able to obtain no specimens from the western United States. The male and female organs seem to have a tendency to appear in alternate seasons on the same plant.

DOUBTFUL OR EXCLUDED SPECIES.

ENTODON MACOUNII C. Muell. & Kindb. in Macoun, Cat. Can. Pl. 6: 177. 1892.

Authentic specimens from type locality in Herb. Macoun are not referable to *Entodon* at all, but are one of the complanate-foliate Hypneae. Capsules are needed to classify them. There are no quadrate alar cells and the cells at the angles are so little enlarged as to be scarcely noticeable.

ENTODON SUBFLACEUS C. Muell. & Kindb. Can. Rec. Sci. **1894**: 21. 1894.

Professor Macoun says in a recent letter, "You will notice that *Hypnum subflaccum* is really what is also described as "*Entodon Macounii.*" This was Kindberg's second name. His first was *C. Drummondi.* His third was *H. subflaccum.*"

ENTODON (?) EXPALLENS C. Muell. & Kindb. in Macoun, Cat. Can. Pl. 6: 177. 1892.

This species belongs to the same group as *E. Macounii.*

CYLINDROTHECIUM FLORIDANUM Duby, Regensb. Flora, **58**: 284, is probably not related to *Entodon*, as the horizontal capsules described are not in accordance with the characters of the genus. We have not been able to obtain a specimen of it, as the type cannot be found in the Duby nor the Boissier herbaria at Geneva.

2. PYLAISIELLA Kindb. Can. Rec. Sci. **1894**: 21. 1894.

[PYLAISIA Br. & Sch. Bryol. Eur. fasc. 46–47. 1851. Not Desv. 1814.]

Gametophyte in rather thin glossy green mats. Stems creeping, subpinnately branching. Branches short, erect or ascending, more or less recurved at the tips by reason of the strongly secund apical leaves; not radiculose. Leaves erect-spreading, somewhat falcate-secund, especially when dry, acuminate, concave, ecostate or costa short and double; leaf cells linear, quadrate at the basal angles. Monoicous; paraphyllia none. Male branches gemmiform, borne on stem or branches. Female branches usually borne on the stem. *Sporophyte* with seta smooth, twisted to left above, to right below. Calyptra cucullate. Capsule erect, seldom slightly incurved; operculum conic or short rostrate. Columella persistent, annulus narrow. Peristome double, inserted below

mouth of capsule; segments attached to a wide basal membrane, free or adhering to teeth; cilia rudimentary or none. Spores minutely roughened.

Widely distributed in the north temperate zone.

The generic name *Pylaisia* was first used by Desvaux in 1814 to designate a new genus named in honor of De La Pylaie. The specimen upon which his genus was founded is stated to be nothing more than a depauperate form of *Hypnum denticulatum* L.

In 1851 Bruch and Schimper took up the name for a new genus founded on *Hypnum polyanthos* Schreb., thus publishing a homonym. DeNotaris in 1869 extended the genus *Pylaisia* by including *Orthothecium* of the Bryol. Eur., and in this extended form it was degraded by Lindberg in 1879 to a sub-genus of *Stereodon* of Mitten. The name *Pylaisiella* proposed by Kindberg for two species of the genus, viz.: *P. velutina* and *P. subdenticulata*, is very appropriate, as it will commemorate the name of De La Pylaie.

Segments of the endostome entirely free from the teeth.	
Operculum conic; quadrate alar cells few.	1. *P. polyantha.*
Operculum short-rostrate; quadrate alar cells numerous.	2. *P. subdenticulata.*
Segments partially or wholly adherent to the teeth.	
Partially adherent; spores 18–24 μ.	3. *P. intricata.*
Wholly adherent; spores 25–30 μ.	4. *P. velutina.*

1. PYLAISIELLA POLYANTHA (Schreb.) Grout, Bull. Torr. Club, 23: 229. 1896.

Hypnum polyanthos Schreb. Spicil. Flor. Lips. 97. 1771.

Pylaisia polyantha Br. & Sch. Bryol. Eur. fasc. 46–47. *pl. 455.* 1851.

Stereodon polyanthos Mitt. Journ. Linn. Soc. 8: 40. 1865.

Pylaisia heteromalla Br. & Sch. Lond. Journ. Bot. 2: 669. 1843.

Hypnum polyanthum pallidifolium C. Muell. Syn. 2: 337. 1851.

Pylaisia Ontariense C. Muell. & Kindb. in Macoun, Cat. Can. Pl. 6: 174. 1892.

Gametophyte in glossy yellowish green intricate mats; stems 2 to 10 cm. long, rarely longer, creeping, pinnately branching; branches 0.5 to 1 cm. long, erect or ascending; branch leaves somewhat falcate-secund, loosely imbricate when dry, broadly ovate-lanceolate, 1–1.3 × 0.4–0.5 mm., more or less long-acumi-

nate, entire, slightly concave, ecostate, or costa very faint, short and double; leaf-cells linear-rhomboidal; median cells 8 : 1; quadrate alar cells few; stem leaves broader, more abruptly acuminate: antheridia oblong; perigonial leaves broadly ovate-lanceolate, entire, acute to acuminate: perichaetium 2 mm. long; the leaves loosely sheathing, squarrose at apex; inner oblong-lanceolate, more or less long-acuminate, more or less serrate at apex, ecostate; cells linear above, rhomboidal and hyaline below. *Sporophyte* 1–2 cm. high; seta red-brown; capsule lighter red-brown, oblong-cylindric, 2.5 mm. long, 3.5–4 : 1, often stomatose at base; operculum conic to conic-apiculate; annulus very narrow and easily detached, of one row of cells; teeth of peristome linear-lanceolate, closely and regularly articulate, sub-moniliform and slightly granular above; segments as long as teeth, linear-lanceolate, strongly carinate, more or less split when old, granular-roughened; spores brownish yellow, minutely roughened, 14μ, maturing in autumn and winter.

Type locality European.

On stems and roots of trees. Not common.

Canada and northwestern United States (Macoun); Kakabeka Falls, Ont. (Mrs. Britton); Saskatchewan and Rocky Mountains (Bourgeau); Santa Fé (Fendler); White Mountains (James); Montana (R. S. Williams); Pike's Peak, Colo. (S. L. Clarke); Minnesota (F. F. Wood); Mt. Desert (Rand, Flora Mt. Desert, 212). Apparently widely distributed in Canada and along the northern border of the United States in mountainous regions, but rather infrequent and local.

ILLUSTRATIONS.—Dill. Hist. Musc. *pl. 42. f. 62* (*Hypnum sericeum ramosius et tenuis*); Hedw. St. Cr. 4: *pl. 2.* (*Leskea polyantha*) Br. & Sch. l. c.; Husnot. Musc. Gall. *pl. 89;* Rab. Krypt. Fl. 4^3: *f. 354.*

EXSICCATI.—Drumm. Musc. Am. 222; Aust. Musc. Appal. Suppl. 1. 537; Macoun, Can. Musc. 260 (in part).

The typical American form of this species is quite variable in leaf characters even on the same plant, but it differs constantly from European specimens in that the leaves are shorter, more abruptly acuminate and more broadly ovate-lanceolate. The length of the leaf of the European form averages 1.5 mm., that

of the American 1 mm., though I have found one plant whose leaves measured 1.4 mm. The length of the acumination of the perichaetial leaves is also very variable. It may be that our forms of this and the next species are but two varieties of the European *P. polyantha*. The American *polyantha* answers very closely to the description of *P. polyantha brevifolia* Lindb. & Arnell, Musc. Asiae-bor. 152. 1890. I have seen the type specimens of *P. heteromalla* from Schimper's herbarium and not only are they *P. polyantha*, but Schimper himself indicated clearly on his labels that he did not consider it a good species; Drummond's no. 222 on which this species was founded, is evidently somewhat mixed as the Columbia Herbarium specimen is *P. intricata*.

1a. PYLAISIELLA POLYANTHA JAMESII (Sull.) E. G. Britton, Bull. Torr. Club, **23**: 230. 1896.

Pylaisia Jamesii Sull. & Lesq. Musc. Bor. Am. Ed. 2. 383. 1865.

Pylaisia subdenticulata obscura Lesq. & James, Mosses North America, 309. 1884.

Gametophyte smaller than in the typical form; leaves shorter, broadly ovate-lanceolate, shortly bicostate; length of leaf-cells 4–6 times their diameter; quadrate alar cells numerous; perichaetial leaves shorter, abruptly acuminate. *Sporophyte* with shorter subulate-lanceolate peristomal teeth, which are also shorter than the segments.

On the ground and roots of trees. Chelsea, Mass. (James).

This variety has the appearance of *P. subdenticulata* because of its reduced size, otherwise it has the characters of American *polyantha*, such as conic operculum and rudimentary cilia.

1b. PYLAISIELLA POLYANTHA PSEUDO-PLATYGYRIA (Kindb.) Grout, Bull. Torr. Club, **23**: 230. 1896.

Pylaisia pseudo-platygyrium Kindb. in Macoun, Cat. Can. Pl. 6: 173. 1892.

Pylaisia filari-acuminata Kindb. l. c. 174.

Leaves narrowly long-acuminate; upper branch leaves distantly serrate-dentate along sides of acumination; inner perichaetial leaves often long-acuminate, serrate-dentate along the acumination; cilia 1 or 2, better developed than in the type.

Type locality, shores of Lake Nipigon, Ontario. Also found on the west side of the Columbia river at Revelstoke, B. C.

On decayed trunks and on "logs subject to inundation."

EXSICCATI.—Macoun, Can. Musc. 626. (*Pylaisia filari-acuminata.*)

2. PYLAISIELLA SUBDENTICULATA (Schimp.) Kindb. Can. Rec. Sci. 1894: 22. 1894.

Pylaisia subdenticulata Schimp. Bryol. Eur. fasc. 46–47. 1851.

Pylaisia denticulata Sull. in A. Gray Man. Ed. 2: 52. 1856.

Gametophyte darker green than the last, scattering or in thin mats, often closely intermixed with other species; stems 1–3 cm. long, irregularly divided, subpinnately branching; branches very short, usually less than 5 mm. long; branch leaves erect-spreading, ovate-lanceolate, 0.7–1×0.2–0.35 mm., gradually long-acuminate, more or less denticulate especially above, concave, ecostate or costa thin, short and double; median cells 6–8 : 1; quadrate alar cells numerous : perigonial leaves ovate-lanceolate, acuminate, concave; antheridia oblong : perichaetium 1.5–2 mm. long, loosely sheathing; inner leaves ovate-lanceolate, gradually or abruptly narrowed to a long point, more or less denticulate above, ecostate; leaf-cells linear-fusiform above, broader and rhomboidal below. *Sporophyte* 8–17 mm. high; seta brown; capsule brown, cylindric, 1.5–2 mm. long, 4–5 : 1; operculum conic, short-rostrate; annulus very narrow, consisting of a row of isodiametric polygonal cells and a row of vesicular cells that often come off with the operculum; teeth of peristome linear-lanceolate, orange, closely and regularly articulate, submoniliform and granulose above; segments linear-lanceolate, a little longer than the teeth, more or less split above; cilia lacking; spores yellow-brown, minutely roughened, 10–12μ, maturing in summer or early autumn.

Type locality American (Sullivant).

On trees. New York and New Jersey (Austin); Maryland (Holzinger); Ohio (H. J. Biddlecome); Athens, Ill. (Hall); New Mexico (E. O. Wooton).

ILLUSTRATIONS.—Sull. Icon. Musc. *pl. 87.*

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 382.

Very close to *P. polyantha*, but distinguished by the reduced size, rostrate operculum, absence of cilia and numerous quadrate alar cells.

3. PYLAISIELLA INTRICATA (Hedw.) Grout, Bull. Torr. Club, **23**: 231. 1896.

Pterigynandrum intricatum Hedw. Sp. Musc. 85. *pl. 18.* 1801.

Pylaisia intricata Schimp. Bryol. Eur. fasc. 46–47. 1851.

Hypnum intricatum C. Muell. Syn. **2**: 338. 1851.

Stereodon intricatus Lindb. Musc. Asiae-bor. **2**: 151. 1890.

Pylaisia Selwynii Kindb. Ott. Nat. **2**: 156. 1889.

Gametophyte in wide glossy-green intricate mats; stems 5–8 cm. long, creeping, pinnately branching; branches about 5 mm. long, erect or ascending, strongly recurved at tips, especially when dry; branch leaves secund, especially at the ends of the branches, ovate-lanceolate, 0.8–1.1×0.3–0.4 mm., more or less long-acuminate, entire or subdenticulate at apex, concave, ecostate or costa short, thin and double; median cells linear-fusiform, 7–12:1; quadrate alar cells numerous, bordering the lower ⅓ of leaf; stem leaves ovate to broadly ovate-lanceolate, more abruptly acuminate, costa short and double; leaf-cells broader, linear-rhomboidal: male branches abundant; antheridia elongated-ovoid; perigonial leaves broadly ovate-lanceolate, acuminate: perichaetium 2–2.5 mm. long, loosely sheathing; inner leaves oblong-lanceolate, acuminate, denticulate above, costa diffuse, reaching middle; leaf-cells linear above, looser, rhomboidal and strongly porose below. *Sporophyte* 12–17 mm. high; seta dark red-brown; capsule red-brown, ovoid to ovoid cylindric, symmetric, slightly narrowed at mouth, 2 mm. long, 3–4:1; operculum conic, erect or oblique; annulus of about 2 rows of cells; teeth of peristome subulate-lanceolate, closely and regularly articulate, light yellow-brown; segments longer than the teeth, adherent for ⅔ their length, split below, united above; spores yellow-brown, minutely roughened, thick walled, 18–24 μ, maturing in autumn.

Type locality, Lancaster, Penn. (Muhlenberg).

On trees, old logs, etc.

Common in the northeastern United States and eastern Canada; Kansas, Missouri, Mississippi, Georgia (Ravenel), Florida (Chapman).

. ILLUSTRATIONS.—Hedw. l. c.; Sull. Icon. Musc. *pl. 88;* Gray's Man. Ed. 2, *pl. 5*; Lesq. & James, Mosses of North America, *pl. 5*.

EXSICCATI.—Sull. Musc. Allegh. 34; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 256, (Ed. 2) 380; Macoun, Can. Musc. 262; Ren. & Card. Musc. Am. Sept. Exsic. 89.

This species is easily distinguished by its curved branches, numerous quadrate alar cells and partially adherent segments. It varies a great deal in length of leaves and in length of leaf-cells, length and color of capsule and size of spores. Authentic specimens of *Pylaisia Selwynii* Kindb. show that it is merely a form of this species growing in exposed dry places. The plants are darker and the leaves more strongly recurved than usual.

4. PYLAISIELLA VELUTINA (Schimp.) Kindb. Can. Rec. Sci. **1894**: 21. 1894.

Pylaisia velutina Schimp. Bryol. Eur. fasc. 46–47. 1851.

Gametophyte in wide glossy yellow-green mats; stems 5 cm. or more long, creeping; branches 5–10 mm. long, ascending, curved at tip; branch leaves loose, secund, especially when dry, ovate-lanceolate, 0.8–1.2 by 0.3 mm., more or less long-acuminate, entire or denticulate along the somewhat involute margin, concave, ecostate, or costa short, faint and double; median cells linear-fusiform, 8–10 : 1; quadrate alar cells few; stem leaves much broader: antheridia stipitate, elongated-ovoid; inner perigonial leaves oblong-ovate to broadly ovate-lanceolate, acuminate: perichaetium 2 mm. long; leaves loosely erect, the inner oblong-lanceolate, long-acuminate, somewhat denticulate at apex; leaf-cells linear above, linear-rhomboidal and porose below. *Sporophyte* 1.2–1.7 cm. high; seta brown; capsule brown, ovoid-cylindric, 2 mm. long, 4:1; operculum conic, strongly apiculate to short-rostrate; annulus narrow, of 2 rows of small cells; teeth of peristome yellow-brown, linear-lanceolate, very closely articulate, bordered the entire length by the adhering segments; spores thick-walled, finely papillose, dark yellow brown, 24–30μ, maturing in late summer or early autumn.

Type locality American, (Sullivant).

On bark of trees, old logs, etc.; New Brunswick, and Mt. Desert, Maine, south to North Carolina, west to Ohio and Indiana.

ILLUSTRATIONS.—Sull. Icon. Musc. *pl. 89.*

EXSICCATI.—Sull. Musc. Allegh. 60; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 257, (Ed. 2) 381; Aust. Musc. Appal. 294; Macoun, Can. Musc. 470.

Distinguished from *P. intricata* by the entirely adherent segments, narrower leaves with fewer quadrate alar cells, and larger spores.

PYLAISIA REVOLUTIFOLIA Kindb. in Herb. Macoun, from Leamington, Ont., August 4, 1892, and Pelee Point, Ont., is *Entodon repens.*

3. HOLMGRENIA Lindb. Öfv. Vet.-Ak. Förh. **19**: 605. 1863.

[ORTHOTHECIUM Br. & Sch. Bryol. Eur. fasc. 48. 1851. Not Schott. & Endl. Melet. Bot. 31. 1832.]

Gametophyte in wide glossy bright colored mats (except *H. intricata*). Primary stems irregularly divided, sparsely branching. Paraphyllia lacking. Leaves erect, ascending, not decurrent, usually entire or sometimes slightly serrulate, acuminate, concave; costa short and double or lacking; median leaf-cells linear; basal cells shorter and broader; alar little differentiated. *Sporophyte* rare. long-pedicelled; seta smooth. Calyptra small, fugacious. Capsule nearly or quite erect and symmetric; operculum conic; annulus large. Peristome double; the teeth narrowly lanceolate; segments lanceolate, as long as teeth, from a broad basal membrane; cilia short or lacking.

Gametophyte large (5–10 cm. high); leaves strongly plicate. 1. *H. chrysea.*
Gametophyte small (2–4 cm. high); leaves not plicate.
Leaves ovate. 2. *H. stricta.*
Leaves narrowly lanceolate. 3. *H. intricata.*

1. HOLMGRENIA CHRYSEA (Schwaegr.) Lindb. Öfv. Vet.-Ak. Förh. **19**: 605. 1863.

Hypnum chryseum Schwaegr. Schulte's Reise auf. d. Glockner, **2**: 364. 1804.

Orthothecium chryseum Br. & Sch. Bryol. Eur. fasc. 48. *pl. 461.* 1851.

Isothecium chryseum Spruce, Annal. & Mag. Nat. Hist. 1849.

Leskea chrysea Hartm. Skand. Flor. Ed. 6. 1854.

Stereodon chryseus Mitt. Journ. Linn. Soc. **8**: 39. 1864.

Gametophyte in thick glossy golden tufts; stems 5–10 cm. long, erect, simple or 2–3 parted, radiculose at base; leaves pluriseriate, imbricate, ovate-lanceolate to triangular ovate, 1.3–2 x 0.4–0.8 mm., apiculate to short acuminate, curved, strongly plicate, nearly ecostate; margins entire, recurved; median cells linear, 12–14: 1; basal cells somewhat shorter and broader, thick-walled and golden brown: dioicous; male branches gemmiform; antheridia short stipulate; paraphyses few, filiform; perigonial leaves ovate, concave, acute to acuminate, serrate at apex: perichaetium 1.5–2 mm. long; leaves few, triangular-ovate, golden brown with several layers at base; the inner long-acuminate, sharply toothed, not plicate. *Sporophyte* 2–3 cm. high; seta golden brown, smooth; capsule ovoid-cylindric, slightly unsymmetric, contracted under the mouth when dry; operculum conic; annulus of two rows of cells, easily deciduous; peristome double; the teeth linear-lanceolate, closely articulate, hyaline and granulose-roughened above; segments from a very wide basal membrane as long as teeth, somewhat perforate along the keel; cilia two, shorter; spores 12–16μ, roughened.

Type locality European.

On moist rocks and stony slopes, in alpine or boreal regions. Rare and rarely fruiting. Rocky Mountains (Drummond, Macoun); Saskatchewan (E. Bourgeau); Columbia Falls, Montana (R. S. Williams); Colorado (Brandegee).

ILLUSTRATIONS.—Br. & Sch. l. c.; Husnot, Musc. Gall. 316. *pl. 90.*

2. HOLMGRENIA STRICTA Lorentz, Moos Stud. 122. *pl. 5.* 1864.

Stereodon rubellus Mitt. Journ. Linn. Soc. 8: 40. 1865.

Orthothecium rubellum Kindb. Laubm. Schwed. u. Norw. 46. 1883.

Orthothecium intricatum var. *rubellum* Husnot, Musc. Gall. 173. 1893.

Gametophyte caespitose, orange colored, glossy; stems erect, 1.5–2 cm. long; branches few; lower branch leaves elongated ovate; upper ovate-lanceolate, 1 x 0.3–0.4 mm., not plicate or sulcate, ending in a flexuous subhyaline acumination; margins revolute, serrulate above; costa short and double; median leaf-

cells oblong-linear, 6–8: 1; basal cells shorter, brownish yellow; alar cells not conspicuously quadrate; stem leaves larger, 1–1.4 mm. long: dioicous; perichaetial leaves ovate-lanceolate. *Sporophyte* lacking.

Type locality European.

Davis Strait (Taylor).

In several sets of Drummond's mosses no. 73, from the Rocky Mountains (distributed as *Catoscopium nigritum*), there is no trace of this species. Dr. Mitten kindly sent a portion of the Davis Strait plant and says that the Taylor who collected these specimens was a ship's surgeon and not the Dr. T. Taylor whose herbarium is at Harvard.

"A small moss with all the habit, appearance and color of *Orthothecium intricatum* Br. & Sch., but differing in its almost exactly ovate leaves, with a short sometimes discolored apiculus, the margins revolute, and the areolation composed of cells which are twice as wide." (*Mitten.*)

3. HOLMGRENIA INTRICATA (Hartm.) Lindb. Öfv. Vet. Ak. Förh. 19: 605. 1863.

Leskea intricata Hartm. Skand. Fl. Ed. 5: 336. 1849.

Orthothecium intricatum Br. & Sch. Bryol. Eur. *pl. 462.* 1851.

Leskea polyantha β sericeola Brid. Bryol. Univ. 2: 313. 1827.

Gametophyte in wide densely intricate mats, dark green to brownish green; stems filiform, 2–4 cm. long, creeping, somewhat stoloniferous, irregularly divided; branches short and erect or elongated and prostrate; leaves equally spreading or slightly secund, appressed-imbricate when dry, narrowly lanceolate, 0.8–1.5 x 0.2–0.4 mm. long, subulate to filiform acuminate, entire, somewhat concave, ecostate, median cells linear, 8–10:1; basal cells shorter and broader, often colored red-brown, alar cells not differentiated: dioicous; inner perichaetial leaves lanceolate, long-filiform, acuminate. *Sporophyte* 15–20 mm. high; seta twisted to the right below, to the left above; capsule erect and symmetric, red-brown, 2–2.5:1; operculum conic; annulus of two rows of cells; peristomal teeth closely and regularly articulate; segments linear, perforate along the keel, longer than the teeth, arising from a narrow basal membrane; spores 8–10μ; seldom fruiting.

Type locality European.

On rocks around Kicking Horse Lake, Rocky Mts., sterile, (Macoun.)

Macoun's specimens are more slender and have smaller, more filiform-pointed leaves than is usual with the European plant. The description of the sporophyte is taken largely from Limpricht's description in Rabenhorst's Kryptogamen Flora.

HOLMGRENIA RUFESCENS (Dicks.) Lindb.

Notes from Dr. Mitten indicate that *Holmgrenia rufescens* (Dicks.) Lindb. has not yet been found in North America. In a letter dated April 21, 1896, he says: "I have looked through all my specimens of *Orthothecium rufescens* and find no trace of any North American examples. All Taylor sent me are in with *O. chryseum*, as are the 221 of Drummond in both my sets. I suppose I must have mistaken one of Taylor's to be the first named."

4. CLIMACIUM Web. & Mohr, Iter Suec. 96. 1804. Also Bot. Taschenb. 252. 1807.

Gametophyte erect, dendroid, with underground creeping stems; rarely decumbent or floating. Primary stems densely radiculose; secondary simple below, fasciculately branching above. Stem and branches covered with branching filaments which are chlorophyll-bearing above. Leaves pluriseriate, decurrent; those of secondary stem squamiform, large, closely imbricated and clasping. Branch leaves smaller, crowded, imbricate. Dioicous; antheridial branches rare, scattering. *Sporophyte* with seta long, smooth, twisted to the right; calyptra dimidiate, long, embracing base of capsule. Capsule erect, cylindric. Operculum conic-rostrate, beak often oblique. Columella persistent. Annulus none. Peristome double; teeth linear-lanceolate, closely articulate, minutely papillose. Segments of endostome as long as teeth, carinate, cleft between the articulations, split to the apex when old, attached to a narrow basal membrane, minutely papillose. Spores minutely papillose.

Capsules 3–4: 1; median leaf-cells 10: 1.	1. *C. dendroides.*
Capsules 5–6: 1; median leaf-cells 2–7: 1.	2. *C. Americanum.*

1. CLIMACIUM DENDROIDES (L.) Web. & Mohr, Iter. Suec. 96. 1804. Also Bot. Taschenb. 252. *pl. 10. f. 2.* 1807.

Hypnum dendroides L. Sp. Pl. 118. 1753.

Leskea dendroides Hedw. Sp. Musc. 228. 1801.

Neckera dendroides Brid. Musc. Rec. 2^2: 14. 1797.

Gametophyte bright glossy green, 7–9 cm. high; branches spreading, flexuous; branch leaves loosely imbricate, 2 x 0.7 mm., the upper oblong-lanceolate; lower ovate-lanceolate, denticulate at base, sharply serrate above, obtuse, bisulcate, costate nearly to apex; basal angles sometimes slightly enlarged; median cells linear-rhomboidal to linear-hexagonal, 7–10: 1; alar and apical cells much shorter and broader; stem leaves larger, 2–3 mm. long, ovate, entire, apiculate: perigonial leaves entire, concave; outer suborbicular, ecostate; inner short-oblong, narrowed at base, apiculate, often slightly costate; antheridia oblong; paraphyses numerous, longer than the antheridia: perichaetium about 5 mm. long; inner leaves oblong to oblong-ovate, slightly serrate at the apex, long-acuminate, thinly costate, costa often short or wanting; leaf-cells linear above, rhomboidal and brownish yellow below. *Sporophyte* 2.5–3.5 cm. high; seta reddish-brown; capsule lighter in color, cylindric, about 4 mm. long, 3–4: 1; operculum often remaining attached to columella; peristome reddish-brown; spores 13–22μ. Fruit rare, maturing in autumn.

Type locality European, probably Swedish.

Wet ground, borders of streams, swamps and lakes, especially in the mountains; more common than is indicated by Lesq. & James in the Manual. Ranging through the northern and western part of the continent from New Brunswick to St. Paul Island, Behring sea; south to New Jersey, Colorado and California. Not recorded from Pennsylvania or the North Central States.

ILLUSTRATIONS.—Dillenius, Hist. Musc. *pl. 40. f. 48;* Web. & Mohr., l. c.; Schwaegr. Suppl. 1^2: *pl. 81;* Br. & Sch. Bryol. Eur. *pl. 437;* Hook. & Taylor, Musc. Brit. Ed. 2. *pl. 25;* Husnot, Musc. Gall. *pl. 90.*

EXSICCATI.—Drumm. Musc. Am. 230; Austin, Musc. Appal. 286; Ren. & Card. Musc. Am. Sept. Exsic. 237.

1a. CLIMACIUM DENDROIDES OREGONENSE Ren. & Card. Bot. Gaz. 15: 59. 1890.

"Differs from the type in the leaves narrowed at base, less serrate at apex, sometimes subentire."

Oregon, Willamette R. (L. F. Henderson). A specimen from Sauvie's Island, Oregon (C. G. Pringle no. 510), is probably referable to this variety, as the leaves are almost entire, although broader instead of narrower than in the typical form.

2. CLIMACIUM AMERICANUM Brid. Sp. Musc. Suppl. part 2: 45. 1812.

Neckera dendroides Americana C. Muell. Syn. 2: 122. 1851.

Gametophyte glossy green, 5–7 cm. high; branches usually straight and tapering; branch leaves closely imbricate, 2 x 1 mm.; upper oblong-lanceolate, broadly auriculate; lower ovate to ovate-lanceolate, denticulate below, sharply serrate above, more acute than in the last, bisulcate, costate nearly to apex; leaf-cells more nearly uniform than in the last; median cells oblong-hexagonal, 5–7:1; stem leaves larger, 2–3 mm. long, entire, apiculate: perigonial leaves as in the last, except less frequently costate, bordered by a row of elongated cells, sometimes slightly denticulate at extreme apex; antheridia oblong, narrowed at base; paraphyses numerous, longer than antheridia; perichaetium about 5 mm. long; the inner leaves oblong-ovate, 4–5 mm. long, slightly denticulate at extreme apex, long-acuminate, thinly costate to above the middle; the lower sometimes ecostate; cells linear above, broader and yellowish brown below. *Sporophyte* 2–3 cm. high; seta brown; capsule cylindric, brown, about 6 mm. long, 5–6:1; peristome reddish-brown, teeth sometimes slightly perforated; spores 14–18μ, maturing in autumn; seldom fruiting.

Type locality, Lancaster, Pa. (Muhlenberg).

Swamps, wet soil and rocks, rotten logs, etc.

This species is exclusively American. It is found in the northern and eastern States, ranging from Canada to North Carolina and probably south to the Gulf; west to Minnesota, Iowa, Illinois and Missouri. "Rocky Mountains eastward," Röll in Hedwigia, **36**: 46. 1897.

ILLUSTRATIONS.—Sull. Mosses of U. S. *pl. 5.* & Icon. Musc. *pl. 97;* Lesq. and James, Mosses of North America. *pl. 5.*

EXSICCATI.—Drumm. Musc. Am. 231; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 402; Austin, Musc. Appal. 287; Macoun, Can. Musc. 265.

This species closely resembles the last, but is darker in color and the branches are more strict, with leaves more closely imbricate. Under the microscope it is readily distinguished by its very broadly auriculate branch leaves.

2a. CLIMACIUM AMERICANUM KINDBERGII Ren. & Card. Bot. Gaz. 15: 1890.

C. Americanum fluitans Aust. Musc. Appal. 49. no. 289. 1870. Name only.

Stems decumbent, irregularly ramulose, often floating; dendroid secondary stems rarely present; stem leaves scattering, ovate; branch leaves ovate-lanceolate, not auriculate, but clasping by enlarged rounded basal angles, seldom sulcate; areolation nearly uniform; median cells oblong-hexagonal, 2–3 : 1. Seta usually much longer and more flexuous than in the species, 2–4 cm. long; teeth of peristome usually more or less perforate.

In swamps, having the range of the species and extending to the Gulf.

Typical form from Lafayette Woods, La. (Langlois).

Hastings, Ontario and Gill River, Canada (Macoun); Dells of the Wisconsin (E. G. Britton); Cambridge, Mass. (F. Boott); Wellesley, Mass. (Miss Cummings); Conn. (Eaton); New York (E. G. Britton); Del. (A. H. Commons); New Jersey (Austin); River Swamps, Fla. (Chapman).

EXSICCATI.—Austin Musc. Appal. 289; Ren. & Card. Musc. Am. Sept. Exsic. 238.

The specimens of Sull. & Lesq. Musc. Bor. Am. Ed. 2, 42. in the Columbia College Herbarium are this variety as are also Drummond's Musc. Am. (S. States) 120.

A well-marked and interesting variety which would stand as a distinct species were it not for the gradations. Frequently the typical form found on the borders of a swamp will gradually change to the variety at the water's edge. The dendroid form, which is frequent in southern swamps, closely resembles *C. dendroides* in appearance and has often been confused with it. It is easily distinguished by its areolation and elongated capsules. Its typical habit is hypnoid and is well represented by Austin's exsiccati. When growing out into the water it sometimes has the habit of a *Fontinalis* with distant leaves.

CLIMACIUM RUTHENICUM Lindb. is not a *Climacium*. Its affinities are uncertain, but is it not one of the Isotheciaceae. It has been referred to *Pleuroziopsis* by Kindberg in his check list of European and American mosses (Can. Rec. Sci. **1894**: 19, 1894.) He associates it with *Hypnum splendens* Hedw. and *H. triquetrum* L. This does not seem to be its natural alliance.

HOMALOTHECIUM Br. & Sch. Bryol. Eur. fasc. 46–47. 1851.

This genus is so closely allied to *Camptothecium* that it is clearly a violation of natural relationships to put it in another family. The nearly erect and symmetric capsule and the incomplete peristome are the only characters associating *Homalothecium* with the Isotheciaceae.

ISOTHECIUM Brid. Bryol. Univ. 2: 355, *pl. 10.* 1827.

Schimper, Synopsis, Ed. 2: 662, separates *Isothecium myosuroides* (L.) Brid. from the genus of which *I. myurum* (Pollich) Brid. remains the type. *I. myosuroides* clearly belongs to the Brachytheciaceae and all our American species are closely allied to it. Thus we have no American species of *Isothecium*.

BRACHYTHECIACEAE.

My studies in this family have been confined principally to the following genus.

BRACHYTHECIUM Br. & Sch. Bryol. Eur. Fasc. 52–54. 1853.

Gametophyte generally large, never minute, prostrate or creeping, irregularly or subpinnately branching. Branch leaves pluriseriate, acute to long-acuminate, usually concave, longitudinally plicate or sulcate; vein extending to the middle or beyond; median leaf-cells linear to linear-rhomboidal, length 5–15 times diameter (3–5:1 in *B. reflexum*); basal cells broader and shorter, alar quadrate. Stem leaves larger and broader; paraphyllia none. Male branches gemmiform. *Sporophyte* with seta smooth to very rough, twisted to the right. Calyptra cucullate, smooth; capsule short, 2–4:1, inclined, arcuate (erect and symmetric in *B. Utahense*, *B. acuminatum*, *B. splendens* and *B. biventrosum*); more or less contracted under the mouth when dry; operculum convex-conic

to very short-rostrate; columella persistent; peristome double; the teeth united at the base, linear-lanceolate, slender pointed, closely and regularly articulate, with a very distinct median line, darker colored and marked with very fine transverse lines below, above lighter and granulose-roughened. Segments lanceolate, attached to a wide basal membrane, more or less split along the keel, granulose-roughened above, usually brownish yellow; cilia two or three, well developed, nodose or appendiculate (except in the four species mentioned above). Spores some shade of brown, nearly smooth to very finely roughened.

The roughening of the spores and the transverse lines on the peristomal teeth are so fine that a magnification of 300–400 diameters is required to bring out these points well.

The genus can be divided into six fairly distinct groups.

I. *Salebrosum* group including *B. salebrosum*, *B. flexicaule*, *B. campestre*, *B. Roteanum*, *B. acutum*, *B. oxycladon*, *B. albicans*, *B. pseudo-collinum* and *B. turgidum.*

II. *Rutabulum* group including *B. rutabulum*, *B. asperrimum*, *B. lamprochryseum* and *B. rivulare.*

III. *Acuminatum* group including *B. acuminatum*, *B. splendens*, *B. biventrosum* and *B. cyrtophyllum.*

IV. *Plumosum* group including *B. plumosum*, *B. populeum* and *B. digastrum.*

V. *Reflexum* group including *B. reflexum*, *B. glaciale*, *B. Starkei* and *B. Novae-Angliae.*

VI. *Velutinum* group including *B. velutinum*, *B. Leibergii*, *B. Idahense*, *B. sub-erythrorrhizon*, *B. collinum*, *B. Utahense*, *B. erythrorrhizon* and *B. Bolanderi.*

I. Costa extending into apex.

Seta very rough throughout.	
Plants very slender; leaf-cells 3–5:1	21. *B. reflexum.*
Plants more robust; leaf-cells 8–10:1.	22. *B. glaciale.*
Seta nearly smooth at base; leaf-cells 5–8:1.	19. *B. populeum.*

II. Costa extending ½–⅔ length of leaf.

1. Branch leaves entire.*

Branch leaves long-filiform acuminate.	
Slender, dioicous.	7. *B. albicans.*
Very stout, monoicous.	9. *B. turgidum.*
Branch leaves narrowly acute to acuminate.	18. *B. p'umosum.*

*The branch leaves of *B. acutum* are often entire.

2. Branch leaves serrate.

A. Seta smooth.

a. Capsule erect and symmetric.*

Synoicous. 30. *B. Utahense.*

Dioicous.

Cilia single. 15. *B. splendens.*

Cilia rudimentary or wanting.

Plants slender; leaves gradually slender pointed. 16. *B. biventrosum.*

Plants more robust; leaves acuminate. 14. *B. acuminatum.*

b. Capsules unsymmetric, more or less inclined.

† Capsules 3–4 : 1, suberect.

Monoicous; enlarged basal cells very numerous and conspicuous. 4. *B. Roteanum.*

Dioicous; only a few basal cells enlarged. 6. *B. oxycladon.*

†† Capsules 2–3:1, strongly inclined or horizontal.†

*Stem leaves gradually narrowed from base to slender apex.

Plants robust; leaves at least 1.8 mm. long.

Stem leaves lanceolate, 0.6 mm. broad. 2. *B. flexicaule.*

Stem leaves triangular-ovate, 1 mm. broad. 5. *B. acutum.*

Plants slender; branch leaves not more than 1.5 mm. long. 8. *B. pseudo-collinum.*

** Stem leaves acuminate.

Dioicous. 31. *B. erythrorrhizon.*

Monoicous.

Branch leaves at least 1.8 mm. long. 1. *B. salebrosum.*

Branch leaves not more than 1.2 mm. long.

Stem leaves broadly ovate. 20. *B. digastrum.*

Stem leaves narrowly ovate to ovate-lanceolate.

Branch leaves oblong-lanceolate, 1–1.2 mm. long. 28. *B. suberythrorrhizon.*

Branch leaves ovate-lanceolate, less than 1 mm. long.

——— gradually acuminate. 26. *B. Idahense.*

——— abruptly acuminate. 29. *B. collinum.*

B. Seta slightly roughened with small distant papillae.

Stems short, irregularly branching; monoicous. 29. *B. collinum.*

Stems long and slender, pinnately branching; dioicous. 31. *B. erythrorrhizon Thedenii.*

C. Seta rough above, nearly smooth below.

Leaves plicate, long acuminate. 3. *B. campestre.*

Leaves not plicate, shorter acuminate. 18. *B. plumosum.*

D. Seta rough throughout, with large crowded papillae.

Cells of branch leaves 5 : 1, unipapillate. 24. *B. Novae-Angliae.*

Cells of branch leaves at least 8 : 1, smooth.

Secondary stems dendroid; leaves ovate and very short-acuminate. 13. *B. rivulare.*

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*_B. cyrtophyllum_ belongs here.

† Capsules of _B. flexicaule_ are sometimes 3–4:1.

Not dendroid; leaves slender pointed.*
- Stem leaves lanceolate. 25. *B. velutinum.*
- Stem leaves ovate to triangular-ovate.
  - Monoicous.
    - Cilia not appendiculate; plants robust, yellow green. 10. *B. rutabulum.*
    - Cilia appendiculate; less robust, green.
      - Stem leaves narrowly ovate. 26. *B. Leibergii.*
      - Stem leaves broadly ovate. 23. *B. Starkei.*
  - Dioicous.
    - Leaves 0.6–0.8 mm. long. 32. *B. Bolanderi.*
    - Leaves at least 1.2 mm. long.
      - Branch leaves decurrent, strongly serrate. 11. *B. asperrimum.*
      - Branch leaves not decurrent, merely denticulate. 12. *B. lamprochryseum.*

1. BRACHYTHECIUM SALEBROSUM (Hoffm.) Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 549.* 1853.

Hypnum salebrosum Hoffm. Deutschl. Fl. 2: 74. 1795.

Hypnum plumosum salebrosum C. Muell. Syn. 2: 359. 1851.

Brachythecium laevisetum Kindb. Bull. Torr. Club, 17: 279. 1890.

Gametophyte in wide glossy yellow-green mats; stems 5 cm. or more long, creeping and radiculose, irregularly to subpinnately branching; branches terete-foliate or seldom complanate-foliate; branch leaves lanceolate, 1.8–2.3 × 0.5–0.65 mm., long-acuminate, serrate above, very concave, bisulcate; costa extending beyond the middle; median cells linear-vermicular, 10: 1; basal cells much shorter and broader; alar quadrate, thin walled; stem leaves ovate-lanceolate, nearly entire, 2–2.5 by 0.8–1.1 mm.: monoicous; male branches gemmiform, borne on the stem; perigonial leaves ovate-lanceolate, acuminate; antheridia oblong-clavate, sessile: perichaetium 2 mm. long; the leaves sheathing at base with spreading points; the inner rather abruptly narrowed into a long filiform acumination, entire or distantly serrate above, costa nearly obsolete.

Sporophyte 1–2 cm. high; seta red-brown, smooth; capsule red-brown, 2.5–3 mm. long, 2.5–3: 1, oblong-ovoid, usually

* *B. lamprochryseum* sometimes assumes a dendroid habit.

strongly arcuate and horizontal; operculum conic-apiculate; annulus very narrow and inconspicuous, often remaining attached to the operculum; teeth of peristome red-brown below; segments nearly as long as the teeth; cilia 2, well developed, nodose or subappendiculate; spores nearly smooth, 15μ, maturing in autumn or early winter.

Type locality European.

On earth, stones, roots and trunks of trees, and rotting wood in woods and moist shady places. Eastern Canada and northern and eastern United States; rarely found west of Minnesota and Nebraska; south to North Carolina; Montana (Dr. F. W. Anderson, R. S. Williams); Idaho (Leiberg); Green Lake and Fraser River (Macoun). Not rare.

ILLUSTRATIONS.—Br. & Sch. l. c.; Lesq. & James, Mosses of North America. *pl. 5;* Husnot, Musc. Gall. *pl. 93*; Rab. Krypt. Fl. 4^3, *f. 364.*

EXSICCATI.—Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 328, (Ed. 2) 487; Austin, Musc. Appal. 312 and 313; Macoun, Can. Musc. 283, 438 (*Hypnum acutum*).

Distinguished from *B. oxycladon*, which it closely resembles, by being monoicous; by the shorter and more curved capsules and the more distant and open leaves, having a looser basal areolation; branch leaves also more slender pointed. The capsules are very variable in length, sometimes almost exactly resembling those of *B. oxycladon.* An extremely variable species as at present understood.

Authentic specimens of *B. laevisetum* Kindb. from the type locality have been examined and no characters could be found to differentiate it from *B. salebrosum.*

A great variation in the appearance of the dried specimens appear to be due to the conditions of drying. Herbarium specimens with the leaves widely spreading and somewhat complanate, upon being wet and dried again took on the appearance that is characteristic of the species, the branches becoming terete-foliate and the leaves much more closely appressed.

1a. BRACHYTHECIUM SALEBROSUM FLACCIDUM Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 550.* 1853.

Gametophyte in wide loose dark green mats; stem and branches slender; branch leaves distant, spreading, more or less complanate,

strongly serrate, apex often twisted; stem leaves very broadly triangular-ovate approaching in outline those of *B. Starkei*, about 2 × 1.2 mm., very slenderly acuminate, slightly serrulate. *Sporophyte* with cilia often 3. Capsule much like that of *B. oxycladon*.

New Brunswick (Fowler); Weehawken, N. J., and Oneida, N. Y. (Austin). *B. salebrosum flaccidum* is the extreme broad-leaved form of the species and may be distinct, but at present our knowledge is insufficient to define it.

2. BRACHYTHECIUM FLEXICAULE R. & C. n. sp.

Gametophyte in wide loosely intricate mats, yellow-green, often brown underneath; stems creeping, densely radiculose, closely applied to the substratum, 5–12 cm. long, pinnately branching; branches 5–10 mm. long, terete-foliate, ascending, attenuate; branch leaves narrowly lanceolate, 2–2.5 × 0.5–0.65 mm., gradually narrowed to a very long slender apex, serrate, concave or bisulcate; margins somewhat reflexed; costa extending ½–⅔ length of leaf; median cells linear-vermicular, 12–14:1; basal cells broader and shorter; extreme alar cells subquadrate: monoicous. *Sporophyte* usually not to be distinguished from that of *B. salebrosum;* capsule sometimes approaching that of *B. oxycladon*, 3–4:1.

Type locality, John's Beach, Newfoundland (Waghorne); on earth, Revelstoke, B. C. (Macoun, sent out as *B. glareosum*); on schistose rocks, Manchester, Vt. (A. J. G.); New Jersey (Austin); on decaying wood, Bradford, Pa. (Burnett); Adirondacks (Mrs. Annie M. Smith).

Type seen.

This species seems to me to be almost identical with *B. salebrosum densum* Br. & Sch. Bryol. Eur. *pl. 550*, but M. Cardot thinks otherwise. It is easily distinguished from all its near allies by the extremely narrow stem leaves, gradually narrowed from just above the base to the apex.

3. BRACHYTHECIUM CAMPESTRE Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 11.* 1853.

Hypnum rutabulum campestre C. Muell. Syn. 2: 368. 1851.

Brachythecium subalbicans De Not. Cronaca, 2: 20. 1867. Epil. 118. 1868.

Gametophyte in wide loose glossy yellow-green mats; stems 5 cm. or more long, decumbent or ascending, often stoloniferous at the ends, subpinnately branching; branches 5–10 mm. long; branch leaves equally spreading to somewhat falcate-secund, lanceolate to ovate-lanceolate, 1.4–2 × 0.4–0.6 mm. long-acuminate, strongly serrate above, concave, costate to the middle or beyond; median cells linear-vermicular 10–12: 1; basal cells shorter and broader; alar quadrate; stem leaves ovate-lanceolate, less strongly serrate, long subfiliform acuminate, 2 × 0.6–1.1 mm., strongly plicate: monoicous; male branches borne on the stem, gemmiform; antheridia oblong-cylindric; paraphyses very long and numerous; perigonial leaves ovate, acuminate: perichaetium 2–2.5 mm. long; leaves sheathing at base, with squarrose points; inner leaves oblong-lanceolate, rather abruptly narrowed into a long filiform serrate acumination, costate. *Sporophyte* 1–2 cm. high; seta red when young, red-brown when old, more or less roughened with rather low distinct papillae, nearly smooth below; capsule red-brown, 2.5–3 mm., 3: 1, unsymmetric and inclined; operculum long-conic, apiculate; annulus narrow, usually adhering to the operculum; cilia 1 or 2, long, nodose and papillose-roughened; spores roughened, 15μ, maturing in autumn.

Type locality European.

On damp earth and stones, in woods and in damp grassy places. Apparently has the range of *B. salebrosum*. As yet no specimens have been reported from farther south than New Jersey. Quesnell, B. C. (Macoun).

Illustrations.—Br. & Sch. l. c.; Husnot, Musc. Gall. *pl. 92*.

Exsiccati.—Aust. Musc. Appal. 314–315.

Scarcely to be distinguished from *B. salebrosum* except by the slightly scabrous seta, rather longer capsule and longer acuminate leaves. There are all grades of roughness of seta and it is doubtful if this species is more than a variety of *B. salebrosum*. *B. oxycladon*, *B. flexicaule*, *B. salebrosum*, *B. acutum* and *B. campestre* grade into each other and are difficult to separate satisfactorily.

4. Brachythecium Roteanum DeNot. Cronaca, 2: 19. 1867; Epil. 117. 1869.

Brachythecium salebrosum var. *cylindricum* Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 550*. 1853.

Brachythecium salebrosum Texanum Aust. Bull. Torr. Club, 6: 44. 1875.

Gametophyte in glossy yellow-green mats; stems creeping, subpinnately branching; branches subjulaceous, 5–12 mm. long, terete-foliate; branch leaves more closely imbricated and appressed than in *B. salebrosum*, ovate-lanceolate, long acuminate, 1.5–2 × 0.45–0.55 mm., serrate above, concave, often bisulcate with reflexed margins; costa extending ½ to ⅔ length of leaf; median cells linear-fusiform, 10–12 : 1; several rows of basal cells much enlarged, quadrate to oblong-hexagonal; lower stem leaves ovate, abruptly narrowed to a long slender acumination, nearly entire, 2–2.4 × 0.9 mm.; areolation much looser; upper stem leaves approaching branch leaves in size and shape: monoicous; male branches gemmiform; inner perigonial leaves ovate, very long-acuminate, entire, ecostate; paraphyses stout, nearly twice the length of the cylindric short-stipitate antheridia: perichaetium 2.25 mm. long; leaves sheathing at base with spreading points; inner oblong-ovate, long acuminate, nearly ecostate and entire. *Sporophyte* 2.5 cm. high; seta red-brown, smooth; capsule red-brown, cylindric, nearly erect, slightly arcuate, about 3 mm. long, 4 : 1; operculum conic-rostrate; annulus (?), cilia 2 or 3, well developed, nodulose; spores granulose roughened, 13μ.

Type locality European.

Dallas, Texas (J. Boll); La., Drumm. Musc. Am. (S. States), 123 "*Hypnum laetum* var ?"

Distinguished from *B. oxycladon* by being monoicous and by the conspicuously enlarged basal cells of the leaves; from *B. salebrosum* by the longer suberect capsule and leaves scarcely or not at all plicate; from both by its much shorter-acuminate perichaetial leaves. The American form here described is clearly distinct from either *B. salebrosum* or *B. oxycladon*, and is referred to *B. Roteanum* on the authority of C. Mueller, who identified a specimen of Boll's collection now in the Columbia Herbarium as *B. salebrosum cylindricum* Br. & Sch. I have not had authentic European material for comparison but the plant described answers very closely indeed to Limpricht's description of *B. Roteanum* (Rab. Krypt. Fl. 4^3 : 72.) The specimen Austin described was from the same locality and collector as the specimen identified by Mueller.

5. BRACHYTHECIUM ACUTUM (Mitt.) Sull. Icon. Musc. Suppl. 99. *pl. 75.* 1874.

Hypnum acutum Mitt. Journ. Linn. Soc. **8**: 33. *pl. 6.*

Brachythecium mammilligerum Kindb. Macoun, Cat. Can. Pl. 6: 192. 1792.

Gametophyte in wide thin glossy-green to yellowish-green mats; stems prostrate, creeping or sometimes floating, 5–10 cm. long, irregularly divided, radiculose at base, branching irregularly pinnatifid; branches few, 5–10 mm. long, frequently somewhat complanate-foliate, not radiculose; branch leaves distant, open, lanceolate to ovate-lanceolate, gradually narrowed from just above the base, ending in a very slender point, 1.6–2 × 0.5–0.7 mm., distantly serrate or entire, very slightly concave, little or not at all plicate; costa extending two-thirds the length of the leaf; median cells linear-vermicular, 10: 1; basal and alar cells shorter and broader, oblong-rhomboidal to quadrate; stem leaves slender pointed, triangular-ovate, nearly entire, 2–2.5 by 1 mm.: monoicous, sometimes polygamous; perigonial leaves ovate-acuminate, bordered by a row of elongated cells: perichaetium 2.5 mm. long; the inner leaves ovate-lanceolate, sheathing at base, open above, abruptly long-filiform acuminate, ecostate. *Sporophyte* 2.5–3.5 cm. high; seta smooth, red-brown, often lighter colored above; capsule red-brown, oblong-ovoid to short cylindric, 3 mm. long, 3 : 1, arcuate and inclined, occasionally nearly symmetric; operculum long conic, apiculate; annulus simple, of 1 or 2 rows of cells; teeth of peristome subulate-lanceolate, orange; segments nearly as long as teeth; cilia 2 or 3, well developed, strongly nodose or appendiculate; spores minutely roughened, 13–15μ, maturing in autumn.

Type seen, from Pack River, British Columbia (Lyall) in Mitten herbarium. On the ground and rotting logs and in moist and swampy places. Northern United States and Canada, across the continent; south to N. J., Ohio and Colorado. Macoun, Can. Cryptogams 110 (*B. salebrosum mammilligerum*).

ILLUSTRATIONS.—Mitt. l. c.; Sull. l. c.

EXSICCATI.—Austin, Musc. Appal. 316.

A careful comparison of a large number of specimens indicates

that this species is distinct from the European *B. Mildeanum* Sch. The aspect of the plant is different in that it has loosely foliate and rather flaccid branches, while *B. Mildeanum* has more robust, densely foliate, turgid branches. The leaves are long, slender-pointed, more like *B. glareosum* than *B. Mildeanum*. Sullivant's figure resembles *B. Mildeanum* more closely than *B. acutum*. Mitten's figure represents the leaf much more accurately. Austin's Musc. Appal. 316, is, however, more like *B. Mildeanum* and Sullivant's figure and may prove to be distinct. There seems to be a complete series of intergradations between this species and *B. salebrosum*. The gradually tapering stem leaves which are seldom plicate and the more slender-pointed and less serrate branch leaves are the characters most easily recognized.

6. BRACHYTHECIUM OXYCLADON (Brid.). Jaeg. & Sauer. St. Gall. Nat. Gesell. 1877–1878 : 323.

Hypnum oxycladon Brid. Musc. Recent. Suppl. **2**: 123. 1812.

Hypnum laetum Brid. Bryol. Univ. **2**: 479. 1827.

Hypnum luteolum C. Muell. Syn. **2**: 357. 1851.

Brachythecium laetum Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 554*. 1853.

Brachythecium spurio-acuminatum C. Muell. & Kindb. in Macoun, Cat. Can. Pl. 191. 1892.

Gametophyte in wide glossy yellow-green intricate mats; stems prostrate, irregularly divided, pinnately branching; branches unequal, 0.5–2.5 cm. long, attenuate at ends; upper branch leaves erect-open, ovate-lanceolate, slightly decurrent, 1.5–2 × 0.45–0.8 mm., acute to slenderly acuminate, apex often slightly twisted, serrulate nearly all around, concave, plicate, upper margins often slightly recurved; costa extending beyond the middle; median cells narrowly linear, 10: 1; areolation gradually becoming shorter and broader toward the base; alar cells quadrate; stem leaves larger, 2–2.5 × 0.9–1.2 mm., often nearly entire, more deeply plicate: dioicous or rarely monoicous; male branches gemmiform, borne on the stem; antheridia oblong to obovoid; paraphyses numerous, stout, longer than antheridia; inner perigonial leaves ovate to oblong-ovate, acuminate, ecostate, loosely areolate: perichaetium 2–2.5 mm. long; leaves sheathing at base; the inner

with spreading points, oblong-lanceolate, abruptly narrowed to a long filiform acumination, nearly entire or somewhat serrulate above, costa thin or wanting. *Sporophyte* 1.5–2.5 cm. high; seta red-brown, smooth; capsule red-brown, oblong-cylindric, suberect, slightly arcuate, somewhat contracted below the mouth when dry, the neck gradually narrowed to the seta, 2.5–3.5 mm. long, about 4 : 1; operculum long conic to conic-rostrate; annulus none; teeth of peristome light red-brown, rather abruptly narrowed to a slender hyaline point; segments from a broad basal membrane, nearly as long as the teeth; cilia two, strongly nodose or appendiculate; spores finely papillose-roughened, about 15μ, maturing in autumn or early winter.

Type locality, Penn. (Ludwig).

On earth rocks, and roots of trees in woods. Northeastern United States and eastern Canada; west to Minnesota, Kansas and Nebraska; Colorado (Brandegee); south to North Carolina and Tennessee; Missouri (Bush). Apparently common.

Exsiccati.—As *H. laetum* Drumm. Musc. Am. (S. States), 122; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 329, (Ed. 2) 488, 489, 490; Austin Musc. Appal. 309; Macoun, Can. Musc. 281, 566 (*B. spurio-acuminatum*); Ren. & Card. Musc. Am. Sept. Exsic. 104, (*B. biventrosum*).

Illustrations.—Br. & Sch. l. c.; Sull. Icon. Musc. *pl. 115*; Husnot, Musc. Gall. *pl. 93*; Rab. Krypt. Fl. 4^3 : *f. 374*.

Type specimens of both *B. oxycladon* and *B. laetum* have been examined. The branch leaves of the former are less serrate than those of the latter but the acumination and serration of the leaves varies so much even on the same plant, that these characters alone cannot be used even to separate varieties. The species is exceedingly variable and difficult to separate from its allies, especially *B. salebrosum*; the difficulty is increased by the fact that the species is very imperfectly dioicous.

Examination has been made of authentic specimens of *B. laetum* var. *fallax* R. & C. (Bot. Centralbl. 44 : 422. 1890), *B. laetum* var. *pseudo-acuminatum* R. & C. l. c.; *B. laetum Roelli* R. & C. l. c., from type locality and from Herb. Cardot. The variety *fallax* seems to be nothing more than a local form with nar-

rower leaves and a more dirty green color; var. *pseudo-acuminatum* is a dwarfed and more caespitose plant, but differs in no essential particular from the ordinary form of *B. oxycladon* except, perhaps, in the more slender pointed branch leaves. Var. *Roellii* is not at all like *B. laetum*, having short julaceous branches and ovate to ovate-lanceolate leaves of about ½ the size of the leaves of *B. laetum*. All of these varieties were sterile and the species in the *salebrosum* group of *Brachythecium* are too closely related to make valid varieties from sterile specimens.

Renauld & Cardot's 104 differs in no essential respect from the ordinary *B. oxycladon* but as compared with the type of *B. biventrosum* it is larger and stouter; leaves broader and less slender pointed, basal areolation that of *B. oxycladon*. I am unable to agree with the opinion expressed by M. Cardot in Hedwigia 35: 308. 310. 1896. M. Cardot tells me that he has not seen type specimens of *B. biventrosum* C. Muell. The specimens communicated by Lesquereux could not have been this species or he would not have confused it with *B. laetum*. *B. biventrosum* is very closely related to *B. acuminatum* as is indicated by the erect capsule, imperfect peristome and general appearance. Specimens of *B. digastrum* of the type collection are very distinct from *B. oxycladon* and are most closely allied to the *plumosum* group as is indicated by the leaf characters and general appearance.

6a. BRACHYTHECIUM OXYCLADON DENTATUM (L. & J.).

Hypnum laetum dentatum L. & J. Mosses of North America 335. 1884.

Brachythecium Sullivantii Br. & Sch. Bryol. Eur. fasc. 52–54: 21. 1853.

Gametophyte often submerged and dirty brownish green below; stems and branches slender, stem leaves broader and shorter, acute to acuminate, serrulate; branch leaves shorter pointed and more strongly serrate, more loosely areolate at base. Seta 3–3.5 cm. long, very slightly roughened at base; operculum short-rostrate; apparently growing in wet places and rocks on earth.

In woods near, and on the banks of the Hackensack River, Closter, N. J. (Austin); on ground in ravines, Louisiana (Langlois); banks of a creek, Saline Co., Missouri (Rev. C. H. Demetrio); swamp, Monkton, Vt. (C. G. Pringle).

EXSICCATI.—Sull. Musc. Allegh. 43, in part only.

7. BRACHYTHECIUM ALBICANS (Neck.) Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 553.* 1853.

Hypnum sericeum gracile albicans Dill. Hist. Musc. 328. *pl. 42 f. 63.* 1741.

Hypnum albicans Neck. Meth. Musc. no. 36. 1771; also Hedw. Descr. et Adumb. 4: 13. *pl. 5.* 1793.

Hypnum flavescens Roth. Fl. Germ. 3: 303. 1800.

Brachythecium pseudo-albicans Kindb. Bull. Torr. Bot. Club, 17: 278. 1890.

Gametophyte in rather loose glossy light-green mats; stems decumbent or ascending, much divided, irregularly branching, slightly radiculose; branches erect or ascending, terete-foliate, slender, 5–15 mm. long; branch leaves decurrent, appressed-imbricate when dry, ovate-lanceolate, smaller and narrower toward the end of the branches, 1.6–2.2 × 0.5 to 0.7 mm., long and slenderly acuminate, entire or rarely slightly denticulate, concave or bisulcate; margins more or less reflexed; costa extending beyond the middle; median cells linear-fusiform, 5–8:1; basal broader and shorter; quadrate alar cells numerous; stem leaves broader, 0.6–1 mm. wide, more abruptly narrowed to the slender acumination: dioicous; perichaetium 2.5 mm. long; the leaves with loosely sheathing bases and spreading points; inner leaves exceedingly long filiform acuminate from an oblong base, nearly entire, costa extending nearly through the body of the leaf. *Sporophyte* 12–20 mm. high, sometimes 2 from 1 perichaetium; seta smooth, red-brown; capsule red-brown, ovoid, 2 mm. long, 2:1, unsymmetric, inclined or horizontal, little or not at all contracted under the mouth when dry; operculum convex-conic; annulus of 2 rows of cells, persistent; teeth of peristome linear-lanceolate, yellow brown; segments somewhat shorter than the teeth; cilia 2 or 3, appendiculate; spores finely roughened, 14–18μ; rarely fruiting.

Type locality European.

On rocks and in dry sandy or grassy places. Rocky Mountains and westward in northern United States and Canada; Agattu, Id. Behring Sea, U. S. S. Albatross; Greenland (Fl. Gr.).

ILLUSTRATIONS.—Dill. l. c.; Br. & Sch. l. c.; Hedw. l. c.; Husnot, Musc. Gall. *pl. 93.*

EXSICCATI.—Macoun, Can. Musc. 285.

Distinguished from *B. salebrosum*, *B. acutum* and other closely allied species by being dioicous and by its very slender pointed and entire leaves. *B. glareosum* which has not yet been found in America is also dioicous but is much more robust and its slender pointed leaves are strongly serrate. *B. pseudo-albicans* Kindb. from the type collection, is a form with leaves rather shorter acuminate, occasionally bearing a very few inconspicuous teeth and with a rather larger number of quadrate alar cells. The leaves, however, are not more denticulate than is sometimes the case with European specimens.

7a. BRACHYTHECIUM ALBICANS OCCIDENTALE R. & C. Bot. Centralbl. **44**: 422. 1890.

More slender, more loosely foliate; leaves subsecund, shorter acuminate, denticulate. Montana (Röll.)

8. BRACHYTHECIUM PSEUDO-COLLINUM Kindb. Macoun, Cat. Can. Pl. 6. 196. 1892.

Gametophyte in loosely intricate, dark green mats; stems creeping, subpinnately branching, radiculose; branches about 5 mm. long, terete-foliate, branch leaves erect-spreading, 1–1.2 × 0.3–0.4 mm., very slightly decurrent, lanceolate, concave, serrate; margins reflexed at base; costa extending to middle; apex acute, slender, twisted; median cells linear, 8–10 : 1; basal shorter and broader, alar quadrate; stem leaves ovate-lanceolate, more loosely areolate, less strongly serrate, slightly bisulcate, 1.4–1.6 × 0.6 mm: monoicous; perichaetium about 2 mm. long, sheathing; inner leaves ovate-lanceolate, costate, rather abruptly narrowed to a long filiform acumination, nearly entire, very loosely areolate, leaf-cells 130 × 23μ. *Sporophyte*, 15 mm. high; seta smooth, red-brown; capsule brown, ovoid-cylindric, 2 mm. long, 2–2.5 : 1, slightly unsymmetric, suberect; operculum long conic, annulus lacking; segments as long as the teeth; cilia well developed, 1 or 2, strongly nodose or subappendiculate; spores 16μ, strongly papillose.

Type locality under a well platform, Canaan Forks, N. B. (J. Moser); type seen. Also collected at Closter, N. J. (Austin).

Sporophyte strongly resembling *B. collinum* but the gametophyte is entirely different in its microscopic characters.

9. BRACHYTHECIUM TURGIDUM (Hartm.) C. Hartm. Kindb. Enum. 294. 1888.

Hypnum turgidum Hartm. Skand. Fl. Ed. 5: 328. 1849.

Hypnum plumosum turgidum Lindb. Musc. Scand. 36. 1879.

Gametophyte in glossy, whitish-green to golden-green tufts; stems creeping, irregularly branching; branches very stout and turgid, julaceous, pointed, sometimes ending in flagellae, 1–3 cm. long; leaves loosely appressed imbricate, somewhat decurrent, lanceolate to broadly ovate-lanceolate, 2.5–3.5 × 0.9–1.2 mm., entire, gradually narrowed to a long filiform acumination, stongly plicate, costate to middle; margins reflexed below; median leaf-cells 12–15:1; basal broader and shorter; alar rhomboid-quadrate; stem and branch leaves little different: monoicous; perigonial leaves entire, sharply acuminate, ecostate; antheridia short-stipitate: perichaetial leaves sheathing, long-acuminate, entire, ecostate. *Sporophyte* 1–2 cm. high; seta red-brown, smooth, twisted to the right below to the left above; capsule 3–3.5 mm. long, 3:1, sub-horizontal, curved, somewhat contracted under the mouth when dry; operculum conic; annulus of one row of cells; cilia one or two, nodose; spores 18–24μ, nearly smooth, maturing in autumn.

Type locality European.

In alpine or boreal regions in grassy or stony places. Battle Harbor, Labrador (Waghorne); Stephen, Rocky Mts. (Macoun); Greenland (Fl. Gr.). This species has much the appearance of *B. glareosum* but differs in its more turgid branches, entire leaves and in being monoicous. Not yet found fruiting in America. The description of the sporophyte is adapted from Limpricht.

10. BRACHYTHECIUM RUTABULUM (L.) Br. & Sch. Bryol. Eur. fasc. 52–54, *pl. 543 and 544.* 1853.

Hypnum rutabulum L. Sp. Pl. 1124. 1753.

Hypnum dentatum var. vul. latissimum operculis obtusis. Dill. Hist. Musc. 295. *pl. 38. f. 29.* 1741.

Brachythecium leucoglaucum C. Muell. & Kindb. Macoun, Cat. Can. Pl. 198. 1892.

Gametophyte robust, in wide, loose mats, glossy yellow-green; stems decumbent, arcuate, 5–10 cm. long, stoloniferous at the ends, irregularly divided, subpinnately branching; branches erect or ascending, 1–2 cm. long, gradually attenuate, terete-foliate to somewhat complanate-foliate; branch leaves loosely erect-spreading, ovate-lanceolate, very slightly decurrent, 1.5–2 × 0.5–0.7 mm., gradually long-acuminate, distantly serrate, slightly concave, scarcely plicate; costa extending ⅔ length of leaf, sometimes toothed on the back above; median cells linear, 15 : 1; basal cells little differentiated, somewhat shorter; stem leaves broadly ovate, more abruptly acuminate, 2–3 × 1–1.5 mm., less strongly serrate; basal leaf cells conspicuously broader and shorter; a few of the cells at the extreme angles enlarged and inflated: monoicous or rarely polygamous; male branches frequent, cylindric, more or less curved; perigonial leaves ovate-lanceolate, gradually long-acuminate, denticulate above: perichaetium about 3 mm. long; leaves sheathing at base with squarrose points; the inner oblong-ovate, rather abruptly narrowed to a very long filiform acumination, denticulate above, ecostate, the outer leaves often short costate. *Sporophyte* 2–3 cm. high; seta red-brown, very rough throughout; capsule red-brown, oblong, arcuate and horizontal, not contracted under the mouth when dry, 2.5–3.5 mm. long, about 1 mm. thick; operculum long-conic, apiculate to subrostellate; annulus of two rows of cells, persistent; teeth of peristome red-brown, margined, stout; segments nearly as long as the teeth; cilia 2 or 3, nodose, some often imperfectly developed; spores roughened, 13–16μ, maturing in winter.

Type locality European.

On the ground and stones in wet places, less frequently on roots and stems of trees and decaying logs. Northern United States and Canada; south to New Jersey and Pennsylvania. Columbia Falls, Montana (R. S. Williams).

Illustrations.—Hedw. Descr. 4: *pl. 12;* Br. & Sch. l. c.; Wils. Bryol. Brit. *pl. 26;* Husnot, Musc. Gall. *pl. 92.*

Exsiccati.—Sull. Musc. Allegh. 45; Sull. & Lesq. Musc.

Bor. Am. (Ed. 1) 331, (Ed. 2) 494 and 495 ; Austin, Musc. Appal. 318 ; Ren. & Card. Musc. Am. Sept. Exsic. 243.

Quite variable in size and shape of leaves and in gross appearance. Macoun's Can. Musc. 591 on which *B. leucoglaucum* C. Muell & Kindb. was founded has the seta very rough and cannot be distinguished from this species.

10a. BRACHYTHECIUM RUTABULUM FLAVESCENS (Brid.) Br. and Sch. Bryol. Eur. fasc. 52–54. *pl. 544.*

Hypnum flavescens Brid. Spec. Musc. h. f. 185. 1812.

Brachythecium platycladum C. Muell. & Kindb. Macoun, Cat. Can. Pl. 6: 195. 1892. Can. Musc. 287, in part.

Plants straw-colored, very stout; stem and branches loosely foliate, turgid ; stem leaves very broadly ovate, concave, abruptly short-acuminate. With the typical form. Montana (R. S. Williams) ; Jamaica Plains, Mass. (E. Faxon).

At first sight this form seems distinct from *B. rutabulum* but there is a complete gradation of forms from the typical plant to the variety. The stem leaves often resemble those of *B. rivulare* but they are longer acuminate and some of the branch leaves are not much different from those of typical *B. rutabulum.*

This variety seems imperfectly dioicous, as both Kindberg and R. S. Williams describe it as dioicous. The Columbia specimen of Macoun's 287 (which is undoubtedly the same as that described by Kindberg) contained plants which bore both male and female branches.

11. BRACHYTHECIUM ASPERRIMUM Mitt. Journ. Linn. Soc. **8**: 33. 1865.

Hypnum vallium Sull. & Lesq. Musc. Bor. Am. Ed. 2, 506. 1865.

Brachythecium Villardi R. & C. Bot. Centralbl. **44**: 442. 1890.

Brachythecium gemmascens C. Muell. & Kindb. Macoun, Cat. Can. Pl. 195. 1892.

Brachythecium spurio-rutabulum C. M. & Kindb. l. c. 197.

Brachythecium Columbico-rutabulum Kindb. l. c. 198.

Brachythecium subintricatum Kindb. Rev. Bryol. **22**: 86. 1895.

Gametophyte in wide loose mats, yellow-green ; stems 5–11 cm. long, decumbent or ascending and arcuate, stoloniferous at the

ends, sparingly radiculose, pinnately branching; branches 5–15 mm. long, attenuate at the ends, terete-foliate; branch leaves rather distant, erect-open, long decurrent, ovate-lanceolate, gradually long and narrowly acuminate, strongly serrate above, somewhat concave and plicate, 1.6 × 0.45–0.6 mm., costate to beyond the middle; median cells linear, 10–15: 1; basal and alar cells little differentiated, somewhat shorter and broader; stem leaves varying from broadly ovate and rather abruptly acuminate to elongated triangular-ovate and gradually long and slenderly acuminate, strongly plicate and decurrent, less strongly serrate, often nearly entire, basal cells more differentiated: dioicous; male plants smaller and more slender; leaves more distant and narrower; antheridial branches large, subglobose; antheridia numerous, large; inner perigonial leaves ovate, abruptly long-acuminate, bordered below by a row of elongated cells, nearly ecostate; the outer obovate and costate: perichaetium 2.5 mm. long; the leaves with sheathing bases and squarrose recurved points; inner leaves oblong-ovate, rather abruptly long filiform-acuminate, costate. *Sporophyte* 2–4.5 cm. high; seta red-brown, very strongly papillose; capsule red-brown, 2.5 mm. long, 2.5–3 : 1, oblong-ovoid, arcuate and horizontal, somewhat contracted under the mouth when dry and empty; operculum conic-apiculate; annulus present; cilia 2 or 3, strongly nodose; spores roughened, 13–20μ, maturing in early winter.

Type locality, British Columbia (Lyall and Douglas.)

On moist rocks and soil. California, Idaho, Montana and intervening territory. Not yet reported east of the Rocky Mts.

ILLUSTRATIONS.—Sull. Icon. Musc. *pl 76*; Mitt. l. c.

EXSICCATI.—Sull. and Lesq. l.c.

Distinguished from *B. rutabulum*, which it resembles by being dioicous and having a much more slender habit. I have examined a portion of the type and find that it has long filiform-acuminate perichaetial leaves, although this is not in accordance with either Sullivant's or Mitten's figures. Specimens of *B. spurio-rutabulum* from Burrard's Inlet (Macoun, Can. Musc. 651) contain *B. asperrimum* mixed with another sterile moss which has very strongly plicate leaves. Authentic specimens of *B. Columbico-rutabulum* from type collection can be separated from *B. asperrimum* by nothing excepting that they are said to be monoicous: no male branches could be found on any of the plants examined. Type specimens

of *B. gemmascens* are certainly dioicous; they grew on a wet log and were apparently submerged at times, thus giving an unusual appearance to the plant: its principal leaf characters are identical with those of *B. asperrimum*. Cardot writes that he is sure *B. Villardi* is distinct from *B. asperrimum*, as he found male and female branches on the same plant. I, however, am not able satisfactorily to differentiate it and a specimen from Cardot himself seems dioicious, as a great abundance of male branches were found on one of the plants examined, but not a single female branch. Specimens of *B. subintricatum* from type collection are not distinguishable from *B. asperrimum*. Macoun, Can. Musc. 560 issued as *B. subintricatum* has long, creeping, pinnately branching stems; branch leaves very narrowly lanceolate; sterile. Almost certainly a different moss from the original.

12. BRACHYTHECIUM LAMPROCHRYSEUM C. Muell. & Kindb. Macoun, Cat. Can. Pl. 6: 199. 1892.

Gametophyte in wide thick tufts, glossy golden-yellow to yellow-green, brown underneath; stems very stout, 5–10 cm. long, creeping and long persisting, ascending at the ends, irregularly divided, sending up numerous secondary stems; secondary stems 3–5 cm. high, irregularly branching, often slightly curved at the ends; branches few or numerous, 5–10 mm. long, terete-foliate; branch leaves distant, open, ovate to ovate-lanceolate, not decurrent, 1.2 x 0.6 mm., acuminate with apex twisted, denticulate all around, strongly plicate; costa stout, extending ⅔–¾ length of leaf; median cells linear-oblong, 7–10:1; basal somewhat shorter and broader; alar not differentiated; stem leaves triangular-ovate, slightly auricled, 2–2.5 × 0.8–1.2 mm., more loosly areolate, very strongly plicate; basal and alar cells oblong to elliptical; costa extending ⅘ the length of the leaf, very slender above: dioicous; male branches gemmiform; perigonial leaves broadly ovate, ecostate, narrowed to a long linear-lanceolate acumination which is 1–2 times as long as the body of the leaf; antheridia oblong, short stipitate: perichaetium 2–3 mm. long; leaves sheathing at base, with squarrose-reflexed tips; inner leaves lanceolate, long filiform-acuminate, nearly ecostate. *Sporophyte* 2–3 cm. high; seta brown, very rough; capsule brown, oblong-cylindric, 2–2.5 mm. long, 2.5–3:1, suberect to horizontal, unsymmetric to arcuate; operculum, annulus and inner peristome unknown; peristomal teeth long filiform-pointed; spores nearly smooth, 16–20μ.

Type locality, Vancouver, Id. (Macoun).

On decaying wood in moist places, Calif. (Bolander); Mt. Shasta and Graham's Ranch, Calif. (Howe); Colorado (Brandegee).

The plant from Comox, Vancouver, Id. from which Kindberg evidently described the sporophyte is *B. asperrimum*, hence some discrepancies in the description. The sterile specimens from Mt. Benson and Mt. Finlayson should be regarded as the type. I have described the sporophyte from one of the collections of Mr. M. A. Howe. This species has much the aspect of *B. turgidum*, but has dentate, shorter pointed leaves and rough seta. It is distinguished from *B. rivulare* by its much longer-pointed leaves.

12a. BRACHYTHECIUM LAMPROCHRYSEUM GIGANTEUM n. var.

Stems much stouter, secondary stems with fewer branches; stem leaves distant, longer, 3–3.5 mm. long, very strongly plicate; extreme alar cells inflated. Capsule ovoid; operculum conic-rostrate; annulus large, persistent; segments as long as teeth, from a very broad basal membrane; cilia 2 or 3, well developed, nodose; spores maturing in winter. Atku Id., Behring Sea. (U. S. S. Albatross, No. 44. June 10, 1894.)

13. BRACHYTHECIUM RIVULARE Br. and Sch. Bryol. Eur. fasc. 52–54. *pl. 546.* 1853.

Gametophyte very robust, in wide thick intricate mats, dark green to yellow-green; stems woody, filiform, creeping, rather sparingly radiculose; young stems distantly foliate with minute leaves, the older apparently leafless, irregularly divided, sending up dendroid secondary stems; secondary stems stout, ascending-arcuate, 3–6 cm. long, nearly free from branches below, irregularly branching above; branches 5–15 mm. long, loosely terete-foliate, tapering; branch leaves erect spreading, ovate to ovate-lanceolate, somewhat decurrent, 1.2–1.5 × 0.5–0.6 mm., acute to short acuminate, dentate above with small sharp pointed teeth, strongly concave or somewhat plicate; margins plain or slightly reflexed below; costa extending ⅔ length of leaf; median cells linear, 10–15 : 1; basal broader and shorter; exteme alar cells abruptly enlarged; leaves of secondary stems very characteristic, distant, broadly ovate, rather abruptly short acuminate, 1.6–2 × 1.1–1.4 mm., concave, more or less plicate, denticulate; costa often forking; median cells

8–10: 1; alar cells abruptly enlarged and inflated; leaves of primary stems triangular-lanceolate, 0.8 × 0.5 mm., loosely areolate, without chlorophyl: dioicous; male branches stipitate, inner perigonial leaves acuminate with broad much twisted apices: perichaetium 2.5 mm. long; leaves sheathing at base with squarrose points; the inner oblong-ovate, rather abruptly long subfiliform acuminate, entire or slightly denticulate, ecostate. *Sporophyte* 1.5–2 cm. high; seta red-brown, very rough; capsule 2–3 by 1 mm., oblong-ovoid, unsymmetric to arcuate, inclined to horizontal; operculum conic-apiculate; annulus large; segments as long as the teeth; cilia one or two, well developed, strongly nodose; spores 13μ, smooth, maturing in early autumn.

Type locality European.

On moist earth in woods; banks of rivers; on stones in springs and brooks; subaquatic. Northern U. S. and Canada, across the continent south to Virginia; Pribiloff Islands (C. H. Merriam). Not yet reported from California or the extreme western United States. Several plants in the Columbia herbarium from California which have been referred to this species, are *B. lamprochryseum.*

ILLUSTRATIONS.—Br. & Sch. l. c.; Husnot, Musc. Gall. *pl. 92.*

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 337, (Ed. 2) 505; Austin, Musc. Appal. 319, 320, 321 and 317 (*B. rutabulum*); Macoun, Can. Musc. 288; Ren. & Card. Musc. Am. Sept. Exsic. 244.

This species is easily distinguished by its short acuminate stem leaves.

A very interesting form from New Brunswick (Fowler) and Bradford, Pa. (Burnett) has secondary stems 8–10 cm. long and apparently erect; the leaves of these specimens are much more distant than usual. Mr. Burnett states that his plant grew in several inches of water, shaded by grasses and sedges. A rather uncommon form has the secondary stems simple and long flagelliform.

13a. BRACHYTHECIUM RIVULARE CATARACTARUM Sauter, Fl. Herzogth. Salzburg. 3: 60. 1870.

Floating, dark green to golden green, brown underneath; secondary stems much elongated, simple or sparingly branched;

branches short, directed forward at an acute angle; leaves much more closely imbricated, especially at the tips of the branches.

On timbers of old dam, Staley's Creek, Virginia; sterile. (Dr. J. K. Small.)

14. BRACHYTHECIUM ACUMINATUM (Hedw.) Kindb. Can. Rec. Sci. **1894**: 72. 1894.

Leskea acuminata Hedw. Sp. Musc. 224. *pl. 56.* 1801.

Leskea setosa Hedw. Sp. Musc. 226. *pl. 57.* 1801.

Leskea Beyrichii Hampe. Linnaea, **13**: 47. 1839.

Hypnum acuminatum C. Muell. Syn. **2**: 334. 1851.

Hypnum erectum Drumm. Musc. Am. 224.

Homalothecium acuminatum Jaeger & Sauer. St. Gall. Nat. Gesell. **1877–1878**: 309.

Gametophyte in wide, rather densely caespitose tufts, green to glossy yellow-green; stems creeping, radiculose, primary branches erect or ascending, 1–3 cm. long, sparingly divided, somewhat radiculose, often with radiculose tips; branchlets unequal, tapering, subjulaceous, terete-foliate; branch leaves erect-imbricated, open and appressed when dry, lanceolate to ovate-lanceolate, somewhat decurrent, 1–1.6 × 0.4–0.6 mm., acuminate, more or less serrate above, concave, somewhat plicate; margins often somewhat revolute; costa extending above middle; median cells linear, 9: 1; marginal cells broader; basal enlarged, quadrate; leaves of main branches deltoid ovate, broader: dioicous; male branches borne on the stem, gemmiform; antheridia oblong, stipitate; perigonial leaves ovate-lanceolate, long-acuminate, concave: perichaetium 2–2.5 mm. long; leaves loosely erect, the inner ovate-lanceolate to oblong-lanceolate, long filiform-acuminate, distantly dentate above, costate nearly to middle. *Sporophyte* 1.5–2 cm. high; seta red-brown, smooth; capsule brown, cylindric, erect or very slightly curved, varying greatly in size, 1.5–3 mm. long; operculum conic to short rostrate; annulus none; teeth of peristome united at base, lanceolate, with slender hyaline papillose-roughened points, red-brown below, margined; segments linear-lanceolate from a narrow basal membrane, slightly papillose-roughened above, about the length of the teeth; cilia very

rudimentary or none; spores minutely roughened, 12–16μ, maturing in autumn.

Type locality, Lancaster, Pa. (Muhlenburg).

On decaying wood, bases of trees, rocks and earth, in woods or shady places. Eastern North America west to Minnesota, south to Missouri and Louisiana; not rare.

ILLUSTRATIONS.—Sull. Icon. Musc. *pl. 116;* Hedw. l. c.; Hampe, Icones Musc. *pl 7.*

EXSICCATI.—Drumm. Musc. Am. (S. States) 124 (*Leskea setosa* var.), 125 (*L. setosa*), 126 (*L. acuminata*); Sull. Musc. Allegh. 72; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 330, (Ed. 2) 491, 492 and 493; Austin, Musc. Appal. 310; Macoun, Can. Musc. 282.

This species is very variable in width of basal membrane, width of segments, shape of leaves and length of acumination, but no one of these variations seems to be correlated with any other.

Hedwig's type has lanceolate branch leaves, becoming broadly lanceolate below; basal membrane of medium width; the plants are small and slender, leaves serrulate above and more contracted at base than usual. The form ordinarily distributed as the species corresponds to Hedwig's *setosa*, but the two cannot be distinguished except as extreme forms of one species. The leaf of *acuminata* figured by Hedwig must be a stem leaf, as the branch leaves of his type are lanceolate. The varieties of the Musc. Bor. Am. of Sull. and Lesq. do not correspond with the original plants.

14a. BRACHYTHECIUM ACUMINATUM RUPINCOLUM (Sull. and Lesq.) Ren. & Card. Rev. Bryol. **20**: 17. 1893.

Hypnum acuminatum rupincolum Sull. and Lesq. Mosses of North America, 336. 1884.

Leskea rupincola Hedw. Sp. Musc. 227. *pl. 54.*

Characterized by an extremely narrow basal membrane. Probably having the range of the species but found most frequently in the southeastern United States.

Var. FILIFORME E. G. Britton, Mem. Torr. Bot. Club, **4**: 185. 1893, is not a *Brachythecium.*

15. BRACHYTHECIUM SPLENDENS Aust. Bot. Gaz. **2**: 111. 1877.

Brachythecium acuminatum subalbicans Ren. & Card. Bot. Gaz. **15**: 60. 1890.

Gametophyte in dense glossy yellow-green mats; stems creeping, closely applied to the substratum, rhizome like, 4–6 cm. long, sending up erect julaceous, densely foliate branches; branches terete-foliate, 5–20 mm. long; branchlets few; branch leaves erect, closely and regularly imbricate, broadly ovate-lanceolate to triangular-ovate, cordate-auriculate, 1.5–2 × 0.6–0.8 mm., concave, 2 to 4 times plicate, distantly and finely denticulate; costa extending ⅔–¾ length of leaf; median leaf-cells linear, 12–15 : 1; basal and alar cells rhomboidal to quadrate; stem leaves broader, deltoid to triangular-ovate : dioicous (?); perichaetium 2.5 mm. long; the leaves sheathing at base with loosely erect tips; the inner ovate to ovate-lanceolate, abruptly narrowed to a long filiform acumination, distantly dentate-serrate above, thinly costate; the outer more strongly serrate and nearly ecostate. *Sporophyte* 15 to 25 mm. high; seta smooth, dark chestnut; capsule dark chestnut, 2–2.5 mm. long without operculum, oblong-cylindric, erect and symmetric; teeth of peristome dark red-brown; segments narrowly linear, from a rather narrow basal membrane, yellow-brown; cilia single, slender.

Type locality, on palmetto trunks, St. Augustine, Fla., Feb., 1877 (J. Donnell Smith); on roots of cypress, Roseville, Fla. (J. D. S.); Louisiana (Langlois).

No capsules except such as were old and deoperculate have been seen. The species is beautiful and distinct. It is distinguished from *B. biventrosum* by its much greater size and brilliant color and lustre. Austin's type is a small form of the species; this, perhaps, led him to confuse it with *B. biventrosum.*

16. BRACHYTHECIUM BIVENTROSUM C. Muell. Bull. Torr. Club, 5: 49. 1874.

Gametophyte loosely caespitose, light green; plants small and slender; stems creeping, subpinnately branching; branches slender, 3–8 mm. long, julaceous, terete-foliate; branch leaves appressed-imbricate, lanceolate to narrowly ovate-lanceolate, gradually narrowed to a long slender point, serrulate with small distant teeth, concave or bisulcate at base; costa extending ⅔ the length of the leaf; median cells linear, 10–13:1; basal cells shorter

and broader; alar quadrate, indistinct: dioicous; inner perichaetial leaves sheathing at base, more or less abruptly narrowed into a filiform reflexed acumination, dentate above, ecostate. *Sporophyte* 10–15 mm. high; seta red-brown, smooth; capsule red-brown, oblong, about 1.8 mm. long and less than half as thick, erect and symmetric; operculum conic, apiculate; annulus lacking; segments of peristome attached to a narrow basal membrane, split between the articulations; cilia single, rudimentary.

Type specimen on trunks and roots of trees in woods near Baton Bouge, La. (Dr. Joor). (Type seen; specimens examined by Mueller were communicated to the Columbia Herbarium by Dr. Mohr.)

B. biventrosum is closely allied to *B. acuminatum*, from which it is distinguished by its smaller size and by its very narrowly pointed leaves with fewer and indistinct alar cells.

17. BRACHYTHECIUM CYRTOPHYLLUM Kindb. Ottawa Nat. 4: 63. 1890.

Gametophyte caespitose; tufts glossy-green, usually densely intricate; stems irregularly divided and branching; branches filiform, subjulaceous, 5–10 mm. long; branch leaves open-erect, appressed-imbricate when dry, ovate to ovate-lanceolate, acute or short acuminate, 0.7 × 0.3 mm., serrulate, very concave; margins reflexed below; costa extending ⅔–¾ length of leaf; median cells fusiform, 4–8 : 1; many basal cells shorter and broader; quadrate alar cells numerous; stem leaves broadly ovate, acuminate, 0.7 × 0.4 mm.; median leaf-cells 3–5 : 1 : dioicous. Sporophyte unknown.

Type locality, Brighton, Northumberland Co., Ontario, October 6, 1888 (Macoun). Type seen.

Roots of trees and old logs. Belleville, Ont. (Macoun); Waterloo, N. Y., Austin, 602; *Hypnum* (*Brachythecium*) *julaceum* sp. nov. (Ms. notes in Austin's herbarium.)

EXSICCATI.—Aust. Musc. Appal. 311. (*Brachythecium acuminatum* var. *setosum*.)

Closely allied to *B. acuminatum*, distinguished by its filiform stems and branches and small leaves with shorter cells.

18. BRACHYTHECIUM PLUMOSUM (Sw.) Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 537.* 1853.

Hypnum plumosum Sw. Disp. Musc. Suec. 66. 1799. Not Huds. or Hedw.

Hypnum pseudo-plumosum Brid. Musc. Rec. 2^2: 108. 1801.

Hypnum flagellare Hedw. Sp. Musc. 282. *pl. 73, f. 1–3.* 1801. (*Fide* Limpricht). Not Dicks.

Hypnum chrysostomum Mx. Fl. Bor. Am. 2: 319. 1803. (*Fide* Limpricht).

Brachythecium rutabuliforme Kindb. Macoun, Cat. Can. Pl. 6: 198.

Gametophyte robust, in wide loosely-intricate mats, brownish-green to golden-green, usually glossy on the surface, brown underneath; stems 3–6 cm. long, creeping, pinnately branching, clinging closely to the substratum at the borders of the mats; branches ascending or erect, straight or somewhat curved, 5–10 mm long; branch leaves equally spreading or somewhat secund, rather loosely erect-spreading, lanceolate to broadly ovate-lanceolate, long-acuminate, 1.1–1.5 × 0.4–0.5 mm., entire or serrulate near apex, more or less concave, decurrent; costa extending ⅔ the length of the leaf; median cells linear, 8–12 : 1; a few basal cells broader and shorter; quadrate alar cells few; stem leaves narrowly triangular-ovate to broadly ovate, acuminate, more loosely areolate, nearly entire: monoicous; male branches abundant; antheridia oblong; inner perigonial leaves ovate-acuminate, bordered by a row of narrow cells, generally costate: perichaetium 1.5–2 mm. long; leaves sheathing with spreading points, oblong-ovate to oblong-lanceolate, rather abruptly narrowed to a long slender acumination, nearly entire, more or less distinctly costate. *Sporophyte* 7–20 mm. high; seta dark red-brown to almost black, rough above, nearly smooth below; capsule chestnut brown, black when old, oblong-ovoid, 2.2–2.5 mm. long, 2.5 : 1, horizontal to suberect, nearly symmetric or slightly curved, slightly contracted under the mouth when dry; operculum conic, almost rostrate; annulus narrow, of a single row of cells; cilia 2 or 3, well developed, appendiculate; spores nearly smooth, 13–16μ, maturing in late autumn.

Type locality European.

Subaquatic, on moist rocks in woods and in brooks, especially in mountain regions. Northeastern United States and Canada; west to Minnesota; British Columbia (Macoun); south to North Carolina.

ILLUSTRATIONS.—Br. & Sch. l. c.; Hedw. l. c.; Wils. Bryol. Brit. *pl. 25;* Husnot, Musc. Gall. *pl. 94.*

EXSICCATI.—Sull. Musc. Allegh. 40; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 332, (Ed. 2) 496 and 498; Austin, Musc. Appal. 325, 326, 327; Macoun, Can. Musc. 289; Ren. & Card. Musc. Am. Sept. Exsic. 110.

18a. B. PLUMOSUM HOMOMALLUM Br. & Sch. l. c. Branches curved at apex, leaves falcate-secund, smaller. With the ordinary form.

EXSICCATI.—Sull. Musc. Allegh. 41 (*Hypnum pseudo-plumosum;* Sull.& Lesq. Musc. Bor. Am. (Ed. 1) 332^b, (Ed. 2) 497.

Distinguished from most of the species by having the seta smooth below and rough above; from *B. campestre* by having the leaves shorter, more abruptly pointed, nearly entire and not plicate; from *B. populeum* by the shorter costa, which does not extend into the apex; all the accessible descriptions speak of the perichaetial leaves as ecostate, but the perichaetial leaves of Limpricht's Bryol. Sil. 242 and Husnot's Musc. Gall. 277a were very conspicuously costate and such was the case in all the American specimens examined. Specimens of *B. rutabuliforme* from the type collection have the seta nearly smooth below instead of very rough and are certainly referable to *B. plumosum.*

19. BRACHYTHECIUM POPULEUM (Hedw.) Br. & Sch. Bryol. Eur. fasc. 52–54, *pl. 535* and *536.* 1853.

Hypnum populeum Hedw. Sp. Musc. 270. *pl. 70. f. 1–6.* 1801.

Hypnum Stereodon Laureri Funck; Brid. Bryol. Univ. **2**: 595. 1827. (*Fide* Limpricht).

Hypnum saxicola Voit; Sturm, Deutschl. Fl. **2**: fasc. 12. 1812.

Brachythecium nanopes C. Muell. & Kindb. Macoun, Cat. Can. Pl. 6: 201. 1892.

Eurhynchium populcum Kindb. Can. Rec. Sci. 1894: 23. 1894.

Gametophyte in wide, loosely intricate mats, dark green to yellowish green; stems 2–5 cm. long, creeping, stoloniferous, attached to the substratum by dense fascicles of radicles, subpinnately branching; branches 3–10 mm. long, terete-foliate; branch leaves erect-spreading; the upper lanceolate; the lower broadly ovate-lanceolate, 1–1.2 × 0.25–0.4 mm., slightly decurrent, subulate acuminate, more or less concave, nearly entire or finely serrate above, margins revolute below; costa stout, extending into the apex; median leaf-cells linear-oblong, 5–8 : 1; several rows of basal and alar cells rhomboidal to quadrate; stem leaves 1.4–1.8 × 0.5–0.6 mm., broadly ovate, slenderly acuminate with apex usually more or less contorted, nearly entire, not plicate or sulcate; leaf-cells broader and shorter: autoicous; male branches gemmiform, abundant; perigonial leaves ovate, abruptly acuminate; the inner faintly costate and serrate at the apex: perichaetium 1.5–2 mm. long; the leaves sheathing at the base, with spreading points, oblong-lanceolate, rather abruptly narrowed to a subfiliform acumination, entire or slightly serrate above; costa well developed. *Sporophyte* 10–15 mm. high; seta red-brown, roughened above with low broad papillae, nearly smooth below, (sometimes nearly smooth throughout); capsule brown, short-ovoid, unsymmetric, horizontal, 2 : 1; operculum very long-conic; annulus persistent, of a single row of cells; segments as long as the teeth, split between the articulations; cilia stout, variable, 1–3, more or less appendiculate; spores finely roughened, about 15μ, maturing in early winter.

Type locality European.

On stones, roots and trunks of trees, northeastern United States and Canada; Revelstoke, B. C. (Macoun); North Carolina (Brid. l. c.).

ILLUSTRATIONS.—Br. & Sch. l. c.; Wilson, Bryol. Brit. *pl. 24*; Husnot, Musc. Gall. *pl. 94*.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 333, (Ed. 2) 499. Austin, Musc. Appal. 328; Macoun, Can. Musc. 441, 548 (*B. nanopes*).

Quite variable in size and shape of leaves and robustness of

growth. Distinguished by its long-conic operculum, percurrent costa and partially roughened seta.

19a. BRACHYTHECIUM POPULEUM MAJUS Br. & Sch. l. c. *pl. 536. β.*

Stouter glossy, nearly bronze-colored, densely foliate, leaves longer; habit of *B. plumosum.*

On damp stones, Newfoundland (Waghorne).

19 b. BRACHYTHECIUM POPULEUM RUFESCENS Br. & Sch. l. c. ζ

Mats depressed, closely adhering to the substratum; branches short, numerous, erect or ascending; stem leaves appressed, shorter and narrower, broadly lanceolate, bronze colored, seta shorter.

On rocks, New Haven, Ct. (Pease).

19c. BRACHYTHECIUM POPULEUM OVATUM n. var.

Often having the appearance of var. *rufescens*, but with the stem leaves broadly cordate-ovate 1.4 by 0.8 mm., concave, margins reflexed below, rather abruptly narrowed to a much shorter subulate acumination; costa very stout, often ending below apex; branch leaves ovate-lanceolate, median cells 5 : 1.

On dry rocks in woods with *Grimmia apocarpa.* Johnson, Vt. (Grout); Peacham, Vt., (Dr. Blanchard); Indian Falls, Owen Sound (Macoun); New Harbor, Newfoundland, Jan. 30, 1891, (Rev. A. C. Waghorne).

20. BRACHYTHECIUM DIGASTRUM C. Muell & Kindb. Macoun, Cat. Can. Pl. 6 : 190. 1892.

Gametophyte in wide, olive-green mats, not glossy; stems radiculose, creeping and closely applied to the substratum, pinnately branching; branches 5–10 mm. long, subjulaceous, terete-foliate; branch leaves loosely appressed-imbricate when dry, erect-open when moist, ovate to oblong-ovate, acute to short acuminate with apex more or less twisted, 0.8–1 mm. long and about ½ as broad, decurrent, bisulcate, very concave; margins reflexed below, serrulate; costa stout, extending ⅔–¾ length of leaf; median cells fusiform-hexagonal, 5–7 : 1; basal much shorter; quadrate alar cells numerous; stem leaves triangular-ovate, longer acuminate,

more loosely areolate at base, less conspicuously serrulate, 1.2 × 0.8 mm.: monoicous; perichaetium 2–2.5 mm. long, sheathing; leaves slightly or not at all reflexed at apex, oblong-ovate, thinly costate, very loosely areolate, rather abruptly contracted into a long filiform flexuous acumination, slightly denticulate or entire. *Sporophyte* 15–20 mm. high; seta red-brown, smooth; capsule brown, oblong-arcuate, subhorizontal, 2–2.5 mm. long, 3 : 1; operculum long-conic, apiculate; segments shorter than the teeth; "cilia nodulose, not appendiculate, annulus none."

Type locality, McKay's bush, Ottawa, Ont., Oct. 12, 1889, (Macoun); Canaan Forks, N. B., 1889, (J. Moser). On rocks.

Authentic specimens from McKay's bush have been carefully studied. The species is entirely distinct from *B. oxycladon*. It is distinguished from that species by the shorter and shorter acuminate leaves, shorter leaf-cells, more numerous quadrate alar cells and shorter capsule. In general appearance it resembles *B. Novae Angliae*, but it is easily distinguished by its being monoicous and having a large area of clearly differentiated quadrate alar cells. Its microscopic characters place it clearly in the section with *B. populeum* from which it is distinguished by the broader branch leaves with shorter costa and by its smooth seta.

21. BRACHYTHECIUM REFLEXUM (Starke) Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 539*. 1853.

Hypnum reflexum Starke; Web. & Mohr. Bot. Taschenb. 306 and 476. 1807.

Leskea laxifolia Hook. Musc. Exot. *pl. 30*. 1818.

Hypnum laxifolium Schwaegr. Musc. Frond. Suppl. 2, 1 : 159. *pl. 143*. 1824. Lesq. & James, Man. 342. 1884.

Hypnum subtenue James, Proc. Acad. Phila. **1855** : 447. 1855.

Rigodium reflexum Kindb. Laubm. Schwed u. Norway, 14. 1883.

Eurhynchium reflexum Kindb. Can. Rec. Sci. **1894** : 22. 1894.

Gametophyte in wide, loosely intricate, dark green mats (occasionally yellow-green in sunny places); stems filiform, 5–10 cm. long, arcuate-procumbent, radiculose at points of contact with substratum, pinnately branching; branches filiform, about 5 mm. long, ascending, terete-foliate, attenuate at apex, not radiculose; branch leaves erect-open, loosely appressed-imbricate when dry,

lanceolate, decurrent, 0.6–0.9 × 0.25–0.4 mm., gradually acuminate, serrate above, slightly concave; costa stout, extending into apex; median cells oblong-rhomboidal to oblong-hexagonal, 3–5 : 1; quadrate alar cells very numerous, extending up the sides of the leaf; stem leaves 0.8–1.2 × 0.5–0.8 mm., deltoid-ovate, long acuminate; acumination equaling ⅓ to ½ entire length of leaf: monoicous; male branches abundant, borne on the stem; antheridia oblong; perigonial leaves ovate, acuminate, very loosely areolate: perichaetium 2 mm. long; leaves sheathing at base with spreading tips; inner leaves oblong-ovate, long-acuminate, entire or serrate at apex, nearly ecostate. *Sporophyte* 10–15 mm. high; seta red-brown, very rough, twisted to the right below and usually to the left above; capsule red-brown to nearly black when old, 2 mm. long, 2 : 1, ovoid, horizontal, not constricted under the mouth when dry; operculum conic, apiculate; annulus of two rows of cells; cilia 2 or 3, stout, appendiculate; spores nearly smooth, 15–18μ, maturing in autumn or early winter.

Type locality European.

On decaying logs, roots of trees and detritus of siliceous rocks. Mountains of northern United States and eastern Canada; west to Lake Huron (Macoun) and Montana (R. S. Williams); Maryland (J. D. Smith).

ILLUSTRATIONS.—Br. & Sch. l. c. Husnot, Musc. Gall. *pl. 94*; Rab. Krypt. Fl. 4^3 : *f. 373*.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 503; Austin, Musc. Appal. 540; Macoun, Can. Musc. 286.

Limpricht l. c. states that the spores are papillose but I have been unable to find rough spores in either European or American material. Easily distinguished from the other American species by its filiform stems and branches and the areolation of the leaves approaching that of *Amblystegium*.

Hooker's type of *Leskea laxifolia* from the Northwest Coast (Menzies) has been seen and Dr. Best, Mrs. Britton and myself are agreed that it is this species.

22. BRACHYTHECIUM GLACIALE Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 542*. 1853.

Gametophyte in loose glossy mats, yellow-green to brownish green; stems creeping or decumbent, subpinnately branching;

branches 5–8 mm. long; branch leaves often somewhat secund, loosely erect-spreading, decurrent, lanceolate, 1–1.2 × 0.4–0.6 mm., smaller toward the end of the branches, narrowly acute to acuminate, serrate, faintly or not at all plicate; costa extending nearly or quite to apex, often toothed on the back above and ending in a spine; median leaf-cells linear-oblong, 8–10 : 1; quadrate alar cells very numerous; stem leaves ovate, long-acuminate monoicous; perigonial leaves ovate, acuminate, serrulate at apex; antheridia short oblong: perichaetium sheathing, about 2 mm. long; inner leaves oblong-lanceolate, rather abruptly filiform acuminate with acumination erect or spreading, serrulate at apex, nearly or quite ecostate. *Sporophyte* 2–3 cm. high; seta red-brown, rough; capsule horizontal, unsymmetric, short-ovoid to subglobose, about 2.5 mm. long, 2 : 1; operculum conic-apiculate; annulus of two rows of cells, persistent; segments a little shorter than the teeth; cilia 2 or 3, long appendiculate in the American specimens; spores nearly smooth, about 12μ, maturing in winter.

Type locality European.

ILLUSTRATIONS.—Br. & Sch. l. c.; Husnot, Musc. Gall. *pl. 94;* Rab. Krypt. Fl. 4^3: *f. 372.*

Collected at Middle Arm, Bay of Islands, Newfoundland, February 11, 1896, by Rev. A. C. Waghorne.

Possesses characters intermediate between *B. Starkii* and *B. reflexum.* From *B. reflexum* it is easily distinguished by its more robust habit, and from *B. Starkii* by the usually percurrent costa. The length of the costa varies considerably even in the same plant.

Through the kindness of Professor Eug. Warming, of Copenhagen, specimens of the Greenland moss referred to *Brachythecium glaciale* Br. & Sch. (Fl. Gr. p. 337) have been seen. They are sterile and are certainly not *B. glaciale.* They resemble slender specimens of *B. rutabulum* more closely than they do any other American species.

23. BRACHYTHECIUM STARKEI (Brid.) Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 541.* 1853.

Hypnum Starkei Brid. Musc. Rec. 2^2: 107. 1801.

Eurhynchium Starkei Kindb. Can. Rec. Sci. **1894**: 23. 1894.

Gametophyte in wide, loose mats, dark green, seldom whitish-green; stems irregularly divided, pinnately branching, decumbent or ascending, arcuate and rooting at the tips; branches 5–20 mm. long, ascending and arcuate at the ends, more or less complanate-foliate; middle branch leaves distant, spreading, ovate-lanceolate, 1.4–1.7 × 0.7–0.9 mm., narrowly acute to acuminate, with apex often twisted, somewhat decurrent, strongly serrate, not plicate or sulcate when moist; costa extending beyond the middle; median cells linear-fusiform, 13 : 1; basal shorter and broader; a few of the alar cells rhomboidal to quadrate; stem leaves broadly ovate, broadly long-acuminate, less strongly serrate, more loosely areolate with a much larger area of rhomboid-quadrate cells at the base and alar angles: monoicous; male branches frequent, gemmiform; perigonial leaves ovate, acuminate, the outer with a well-defined costa: perichaetium 2.5 mm. long; leaves loosely sheathing with squarrose points; inner leaves oblong-lanceolate, gradually long and narrowly acuminate, costate, nearly entire; outer leaves shorter, ecostate. *Sporophyte* 2–2.5 cm. high; seta red-brown, roughened with large distinct papillae; capsule oblong-ovoid, dark red-brown, 2–2.5 mm. long, ½ as thick, strongly arcuate, horizontal, slightly narrowed under the mouth when dry; operculum conic; annulus of about two rows of cells; segments a little shorter than the teeth; cilia 2 or 3, appendiculate; spores nearly smooth, about 14μ, maturing in winter.

Type localities European.

On decaying logs and stumps in moist mountain regions. Northern United States and Canada across the continent; Vancouver Island (Macoun); Montana (R. S. Williams); south to New Jersey and Pennsylvania.

ILLUSTRATIONS.—Br. & Sch. l. c.; Husnot, Musc. Gall. *pl. 94;* Rab. Krypt., Fl. 4[3]. *f. 368.*

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 336, (Ed. 2) 504; Austin, Musc. Appal. 323.

Fragmentary specimens of *Hypnum oedipodium* Mitt. (Journ. Linn. Soc. **8**: 32. 1865) of the type collection and from both the localities cited in the original description have been examined and could not be differentiated from the ordinary American *B. Starkei.* Specimens of *B. curtum* Lindb. identified by Lindberg him-

self, have been accessible through the kindness of V. F. Brotherus. The costa of the upper branch leaves was often found ending in a spine, and the cilia were also appendiculate. I have thus far been unable to differentiate *B. curtum* from *B. Starkei* in either American or European material. All the characters given as distinctive are quite variable, even on the same plant in many cases. The majority of the specimens of *B. Starkei* from northeastern North America are more loosely intricate and straggling than the typical European plant, they are also markedly complanate foliate and the costa often ends in a spine and is toothed on the back above. These forms are probably referable to var. *complanatum* Limpr. l. c.

24. BRACHYTHECIUM NOVAE-ANGLIAE (Sull. & Lesq.) Jaeger & Sauer. St. Gall. Nat. Gesell. **1876–1877**: 328.

Hypnum Novae-Angliae Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 338. 1856. Sull. Mosses of U. S. 76. 1856.

Eurhynchium Novae-Angliae Kindb. Can. Rec. Sci. **1894**: 23. 1894.

Gametophyte in wide loosely intricate mats, bright green on the outside, dirty brownish-green below, stems decumbent; secondary stems sub-erect, about 5 cm. long, subpinnately branching; branches erect-ascending, terete-foliate, subjulaceous, not attenuate, 5–10 mm. long; branch leaves erect-open, loosely appressed-imbricate when dry, ovate, decurrent, 0.8 × 0.4–0.5 mm., serrulate, very concave, not plicate, long acute to short acuminate; apex twisted ½ turn to the right; costa thick, extending beyond the middle of the leaf; median leaf-cells oblong-hexagonal, 5 : 1; alar and basal cells little differentiated; each leaf-cell with a small papilla at one end; stem leaves broadly ovate to triangular-ovate, 1 × 0.8 mm., longer acuminate; leaf-cells shorter: dioicous; male branches gemmiform; antheridia oblong; perigonial leaves oblong-ovate, gradually long-acuminate: perichaetium about 2 mm. long; the leaves with sheathing bases and squarrose points; inner leaves oblong, long filiform-acuminate, somewhat serrulate above, costate. *Sporophyte* 1–2 cm. high; seta dark red-brown, very rough with broad low papillae; capsule dark red-brown, almost black when old, oblong cylindric, 3–3.5 mm. long, 4–5 : 1, somewhat arcuate, horizontal to suberect; operculum long-conic, subrostellate; annulus large; segments nearly as long as the

teeth; cilia one or two, nearly as long as the segments, strongly nodose; spores minutely roughened, 17–19μ, maturing in autumn.

Type locality, mountains of New England.

On earth and stones in wet shady places, especially in mountain regions. Northeastern United States and eastern Canada; south to Maryland; west to Wisconsin.

ILLUSTRATIONS.—Sull. Icon. Musc. *pl. 118.*

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 338, (Ed. 2) 507; Aust. Musc. Appal. 329; Macoun, Can. Musc. 440; Ren. & Card. Musc. Am. Sept. Exsic. 109.

Easily distinguished by its rostellate capsule, short leaf-cells and twisted leaf apices. The species varies considerably in length of the acumination of leaves so that var. *Delamarei* Ren. & Card. Fl. Miq. 50, does not seem worthy of special mention, although I have not seen specimens of that form.

25. BRACHYTHECIUM VELUTINUM (L.) Br. & Sch. Bryol. Eur. fasc. 52–53. *pl. 538.* 1853.

Hypnum velutinum L. Sp. Pl. 358. 1753.

Hypnum intricatum Schreb. Sp. Flor. Lips. 1771.

Hypnum declivum Mitt. Journ. Linn. Soc. **8**: 33. *pl. 6.* 1865.

Brachythecium pseudo-erythrorrhizon Kindb. Hedwigia, **35**: 68. 1896.

Gametophyte in wide, dark green to light yellowish-green mats; primary stems about 5 cm. long, creeping, radiculose with fascicled radicles, irregularly divided, very sparingly leafy, leaves often reduced or even wanting in places, branching irregularly pinnate; branches short, 2–5 mm. in length; branch leaves loosely spreading, somewhat falcate-secund at the ends of the branches, lanceolate to ovate-lanceolate, 1–1.3 × 0.25–0.30 mm., gradually long-acuminate; apex usually falcate or twisted; margin serrate; costa extending beyond the middle, often toothed above on the back; median cells linear, 12:1; quadrate alar cells very few, confined to the extreme angles; stem leaves more narrowly lanceolate, usually longer acuminate, often much reduced in size: monoicous; male branches gemmiform; antheridia short-oblong, nearly sessile; inner perigonial leaves ovate-lanceolate, acute, bordered

by a row of elongated cells: perichaetium 2 mm. long; leaves few, sheathing at base, the inner oblong-ovate, rather abruptly narrowed to a long acumination, sharply dentate above; costa wanting or short and slender. *Sporophyte* 15 mm. high; seta light brown, sometimes reddish, very rough, slightly or not at all twisted; capsule brown, short-oblong, arcuate, horizontal, contracted under the mouth when dry, 2–2.5 mm. long, 2–3:1; operculum conic; annulus large, easily detachable; segments lanceolate, as long as the teeth, attached to a basal membrane of median width, more or less split along the keel; cilia 2 or 3, nodose or subappendiculate; spores yellow-brown, minutely roughened, 10–13μ, maturing in autumn or winter.

Type locality European.

On earth or stones and trunks of trees at the base, in shady places. Northern United States and Canada, south to New Jersey; Calif. (Howe).

ILLUSTRATIONS.—Dill. Hist. Musc. *pl. 42, f. 61;* Br. & Sch. l. c.; Mitt. l. c.; Wils. Bryol. Brit. *pl. 26;* Husnot, Musc. Gall. *pl. 95.*

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 500; Austin Musc. Appal. 324; Macoun, Can. Musc. 379.

Varying a great deal in robustness, roughness and length of seta and color of capsule, capsule often yellow-green. "A very variable species, plants slender or robust; stems more or less divided, and the branchlets varying in length; leaves close or more distant, bright green or yellow, opaque or glossy; capsule subglobose or oblong, on a short or long pedicel." Lesq. & James, Mosses of N. A., p. 340. *B. pseudo-erythrorrhizon* Kindb. is inserted as a synonym on the authority of M. Cardot (*Vide* Hedwigia **35**: 308, 1896) as no specimens have been accessible.

26. BRACHYTHECIUM LEIBERGII n. sp.

Gametophyte in wide densely intricate green mats; stems decumbent or ascending, 3–5 cm. long, pinnately branching; branches 5–10 mm. long; branch leaves falcate-secund, decurrent, 1.2 × 0.4 mm., lanceolate, bisulcate or often plicate, gradually very slenderly acuminate, serrate, costate to beyond the middle; median cells fusiform, 8–10: 1; basal shorter and broader; quadrate alar cells numerous; stem leaves ovate to ovate-lanceolate, more strongly

plicate: monoicous; male branches abundant, perigonial leaves ovate, acuminate, 1.4–1.6 × 0.6 mm.; costa lacking or faint: perichaetium 2.5 mm. long, loosely sheathing; leaves oblong-ovate, abruptly filiform-acuminate, nearly ecostate. *Sporophyte* 1.5–2 cm. high; seta red-brown, roughened with rather low blunt papillae, little twisted; capsule light brown, 1.5 mm. long, 1.5–2 : 1, short-ovoid, unsymmetric, horizontal; operculum short conic; annulus present; segments as long as teeth, cilia two or three, well-developed, appendiculate; spores smooth, 10–12μ, maturing in winter or early spring.

Type locality, summit of "Bareknob" Traille River Basin, Idaho, alt. 5500 ft. (J. B. Leiberg, 288. July, 1891).

The gametophyte closely resembles *B. erythrorrhizon*, from which it differs in the rough seta and in being monoicous. Easily distinguished from *B. velutinum* by the larger stem leaves.

27. BRACHYTHECIUM IDAHENSE R. & C. Bot. Gaz. 15: 60. 1890.

Gametophyte in bright green, loosely intricate tufts; stems creeping, irregularly pinnate, branches ascending, somewhat curved at the ends, about 5 mm. long; branch leaves loosely erect-spreading, subsecund; more or less falcate, 0.6–0.9 × 0.3–0.4 mm., ovate-lanceolate, acuminate, strongly serrate, concave; margins reflexed below; costa stout, extending $\frac{2}{3}$–$\frac{3}{4}$ length of leaf; median cells linear-vermicular, 6–8 : 1; basal cells broader and shorter, alar quadrate; stem leaves larger, 0.8–1 × 0.35–0.5 mm., lanceolate from an ovate base, long-acuminate, plicate; basal cells more enlarged: monoicous; perichaetium 2 mm. long, sheathing; inner leaves nearly erect, oblong-lanceolate, very abruptly acuminate, serrate, nearly ecostate. *Sporophyte* 10–17 mm. high; seta red-brown, smooth; capsule 1.5–2.5 × 1 mm., ovoid, unsymmetric and horizontal; operculum obtusely conic; annulus large, of two rows of cells; segments as long as teeth; cilia 2, long, nodulose to subappendiculate; spores roughened, 10–12μ maturing in autumn.

Type locality, Lake Pend d'Oreille, Idaho, on logs. (Leiberg No. 130 in part); also Belt Mts. Montana, November 3, '91 (R. S. Williams).

Type specimens examined. This moss is clearly one of the *velutinum* group and is most likely to be mistaken for *B. suberythrorrhizon* or *B. collinum;* it differs from the former in the smaller, shorter leaves and abruptly acuminate perichaetial leaves; from the latter in the more robust habit and the less abruptly acuminate and falcate stem and branch leaves. The seta often bears traces of papillae. The author remarks, l. c., that "This species rather resembles *B. Bolanderi*, from which it is distinct by the smooth pedicel, monoecious inflorescence, the thicker capsule, the larger size and bright green tint of the tufts. It is more closely allied to the European *B. olympicum* Jur. from which it differs in the larger size, the larger broader plicate leaves, the basal areolation looser, with angular cells more numerous, quadrate, thin-walled, the costa narrower and shorter and the lid obtuse, not apiculate."

28. BRACHYTHECIUM SUBERYTHRORRHIZON Ren. & Card. Bot. Gaz. 19: 238. 1894.

Gametophyte in thin tricate mats, green; stems creeping, subpinnately branching; branches 3–5 mm. long, decumbent or ascending; branch leaves oblong-lanceolate, long and slenderly acuminate, somewhat falcate, 1–1.2 × 0.3–0.35 mm., strongly serrate above, strongly concave or bisulcate, margins reflexed; costa extending beyond the middle; median cells linear, 10–15: 1; basal broader and shorter; quadrate alar cells numerous; stem leaves oblong-lanceolate to ovate-lanceolate, 1.4 × 0.4–0.5 mm.: monoicous; perichaetium about 2 mm. long; leaves sheathing at base with erect-spreading points, ovate to ovate-lanceolate, filiform-acuminate, serrate at apex. *Sporophyte* 12–15 mm. high; seta smooth, red-brown; capsule brown, ovoid, suberect to horizontal, 2–2.5 by 1 mm., little or not at all contracted under the mouth when dry; operculum conic; annulus large, easily detachable, often coming off with operculum; segments as long as the teeth; cilia 1 or 2, well developed, nodose; spores 13μ, slightly roughened.

Type locality, Springdale, Boulder Co., Colorado (Mary Holzinger). Type seen.

"Nearly allied to *B. erythrorrhizon* Br. & Sch. from which it differs in the narrower leaves and the looser areolation." Also in

the shorter pointed leaves and in being monoicous. Too close to *B. Idahense* from which it is distinguished by the larger, narrower leaves and gradually acuminate perichaetial leaves.

29. BRACHYTHECIUM COLLINUM (Schleich.) Br. & Sch. Bryol. Eur. fasc. 52–54, *pl. 548*. 1853.

Hypnum collinum Schleich. Cat. 1815.

Leskea Fendleri Sull. Mem. Am. Acad. **4**: 169. *pl. 1*. 1849.

Hypnum Fendleri Sull. Icon. Musc. 189. *pl. 117*. 1864.

Brachythecium Hillebrandi Lesq. Mem. Calif. Acad. 1[1]: 33. 1868.

Eurhynchium collinum Kindb. Can. Rec. Sci. **1894**: 22. 1894.

Gametophyte small, slender, in thin intricate mats, bright green and glossy above, often dirty green below; stems creeping, radiculose, much branched; branches erect, slender, usually julaceous, often subdivided, 3–6 mm. long, terete-foliate; branch leaves closely imbricate, ovate to broadly ovate-lanceolate, 0.3–0.5 × 0.7–0.9 mm., rather abruptly acuminate, serrulate at base, sharply serrate above, concave; costa extending to middle; median cells linear-oblong to fusiform, 3–6:1; quadrate alar cells numerous, usually chlorophyllose, extending up the margin; stem leaves broadly ovate: monoicous; male branches gemmiform, numerous, borne on the branches; antheridia oblong; inner perigonial leaves ovate-lanceolate, acuminate, serrate, ecostate: perichaetium 1.8–2 cm. long; inner leaves oblong-ovate, abruptly narrowed to a slender acumination, serrate; costa thin and short or wanting; upper leaf cells linear, the lower broader. *Sporophyte* 5–12 mm. high; seta yellow-brown, smooth or slightly roughened; capsules brown, ovoid, unsymmetric to arcuate, contracted below the mouth when dry, 2 mm. long, 2:1; operculum conic; annulus broad, of two rows of cells, easily detached; the segments as long as the teeth, lanceolate, attached to a basal membrane of medium width; cilia well developed, one or two, with sometimes rudiments of a third, nodose; spores yellow-brown, very nearly smooth, 10–12μ, maturing in autumn.

Type locality European.

On earth and rocks in mountains of western United States and

Canada; Peace River, Mt. Shasta, Colorado, Montana, New Mexico, and intermediate points; Greenland (Fl. Gr.).

ILLUSTRATIONS.—Br. & Sch. l. c.; Sull. l. c.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 501, (*Hypnum Fendleri*); Macoun, Canadian Musci, 398; Röll 1540, 1540[a], 1565[a]. Ren. & Card. Musc. Am. Sept. Exsic. 107.

After a critical examination of two sets of Fendler's collection from the type locality of *Leskea Fendleri*, no valid distinction between this and *B. collinum* could be detected as the setae of *B. collinum* is usually slightly roughened in both European and American specimens. Also one capsule of Fendler's plant had two well developed cilia. No specimens of *Brachythecium Hillebrandi* of the original collection have been accessible and all the specimens examined which have been referred to this are undoubtedly *B. collinum*. There are no distinctions except the shorter capsule, rough seta and simple annulus. The length of capsule is always subject to considerable variation.

B. collinum frequently has a rough seta and the terms simple and compound, as applied to the annulus, have been used in a very loose way.

30. BRACHYTHECIUM UTAHENSE James, Bot. King Exped. 409. 1871.

Hypnum Utahense Lesq. & James, Mosses of North America, 339. 1884.

Eurhynchium Utahense Kindb. Can. Rec. Sci. **1894**: 22. 1894.

Gametophyte light green, loosely caespitose, small and slender; stems short, creeping, radiculose, irregularly branching; branches 3–5 mm. long; branch leaves pluriseriate, loosely imbricate, oblong-lanceolate to ovate-lanceolate, 0.9 × 0.3–0.4 mm., acuminate, serrulate below, serrate above, somewhat concave; margins slightly reflexed below; costa extending to the middle or beyond; median cells linear-fusiform, length 6–9 : 1; quadrate alar cells numerous : synoicous; antheridia mixed with the archegonia, oblong : perichaetium 0.8 mm. long; inner leaves serrate, acuminate from a broad sheathing base, ecostate. *Sporophyte* about 5 mm. high; seta brown, smooth; capsules brown, subglobose to oblong-ovoid, erect, nearly or quite symmetric, 2 mm. long, 3 : 1; operculum long-conic; annulus obscure; segments linear-lanceolate, as long as the teeth; basal membrane comparatively narrow; cilia rudi-

mentary, 1 or 2; spores yellow-brown, very slightly roughened, 10–15μ, maturing in winter.

Type locality, sandstone rocks overhanging a dry stream bed near Hanging Rock Station, Echo Canyon, Utah, Alt. 6000 feet (Watson); also found at Bald Mt., western Montana (Watson); Arizona (Pringle).

ILLUSTRATIONS.—Sull. Icon. Musc. Suppl. *pl. 73.*

Closely allied to *B. collinum* but easily distinguished by the erect capsule and rudimentary cilia.

31. BRACHYTHECIUM ERYTHRORRHIZON Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 547.* 1853.

Eurhynchium erythrorrhizon Kindb. Can. Rec. Sci. **1894**: 23. 1894.

Gametophyte in wide, intricate mats, light green, somewhat glossy; stems slender, 4 cm. or more long, radiculose, pinnately branching, not stoloniferous; branches 3–8 mm. long, ascending, the longer often arcuate and decumbent; branch leaves erect-spreading, 1–1.5 × 0.3–0.5 mm., more or less falcate-secund, lanceolate to ovate-lanceolate, gradually long and narrowly acuminate, serrate above, often plicate, costate to above the middle; margins more or less reflexed; median cells linear-vermicular, 8–10 : 1; quadrate alar cells distinct; stem leaves larger, ovate to ovate-lanceolate, plicate, nearly entire : dioicous; perichaetial leaves loosely erect, ovate to oblong-lanceolate, long and narrowly acuminate. *Sporophyte* 10–15 mm. high; seta red-brown, smooth; capsule red-brown, ovoid, unsymmetric and horizontal, 2 mm. long, 2–2.5 : 1; operculum conic, apiculate; annulus present; segments somewhat shorter than the teeth; cilia 1 or 2, well developed; spores 14–20μ, roughened, maturing in autumn.

Type locality European.

Washington, Clealum Lake Ridge (Röll) no. 933; Belt Mountains and Columbia Falls, Montana (R. S. Williams); Colorado (Brandegee); White Mountains (Austin, 1872); Newfoundland (Rev. A. C. Waghorne).

ILLUSTRATIONS.—Br. & Sch. l. c.

Careful comparisons of this species with specimens of *B. harpi-*

dioides C. Muell. & Kindb. Macoun, Cat. Can. Pl. 6 : 194, make it almost certain that the two are identical. Although Prof. Macoun assures me that the specimens sent are identical with Kindberg's types, the plant from New Brunswick is not the same as that from British Columbia which appears to be *B. erythrorrhizon*.

31a. BRACHYTHECIUM ERYTHRORRHIZON THEDENII (Br. & Sch.) Lindb. Musc. Scand. 36. 1879.

Brachythecium Thedenii Br. & Sch. Bryol. Eur. fasc. 52–54. *pl. 17*. 1853.

Stems 5–10 cm. long, slender and creeping, often stoloniferous; branching regularly pinnate; branch leaves long filiform-acuminate; perichaetial leaves very long filiform-acuminate. Seta distantly but distinctly papillose.

Errol Dam, Androscoggin River, N. H. (James).

The variety is one of the rarest of mosses, found in Europe. only in Finland and Sweden.

James' plant has been carefully compared with authentic European specimens and differs chiefly in the larger leaves which approach the typical form. The slightly scabrous seta is a character not heretofore noted, but it is quite conspicuous in specimens from Sweden which were identified by Schimper himself.

Schimper's figure exaggerates the serration of the perichaetial leaves.

32. BRACHYTHECIUM BOLANDERI (Lesq.) Jaeger & Sauer. St. Gall. Nat. Gesell. 1877–78 : 324.

Hypnum Bolanderi Lesq. Trans. Am. Phil. Soc. 13 : 12. 1869.

Eurhynchium Bolanderi Kindb. Can. Rec. Sci. 1894 : 22. 1894.

Gametophyte in wide, pale green mats; stems 3–5 cm. long, irregularly divided, creeping, subpinnately branching, sparsely radiculose; branches 3–6 mm. long, ascending, terete-foliate; branch leaves erect-spreading, rather distant, ovate-lanceolate, gradually acuminate, 0.6–0.8 × 0.25–0.3 mm., serrate all around, not concave or plicate, costa extending beyond the middle; median leaf-cells rhomboidal-fusiform, 5–10 : 1; basal cells shorter and broader; quadrate alar cells few; stem leaves smaller, less distinctly

serrate, often nearly entire: dioicous; perichaetium 2 mm. long, loosely sheathing; inner leaves oblong-lanceolate, long filiform-acuminate, serrate with a few distant teeth, costa slender or lacking. *Sporophyte* 1–1.5 cm. high; seta blood red, very rough; capsule brown, 1.5–2 mm. long, 2: 1, ovoid, unsymmetric, horizontal; operculum conic-apiculate; annulus large, compound; teeth of peristome red-brown below; segments a little shorter than the teeth, from a broad basal membrane; cilia 2, as long as the segments, nodose; spores nearly smooth, about 10μ, maturing in April.

Type locality, on shaded ground, Calif. (Bolander); also collected at Olema, Marin Co. (Howe).

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 502.

DOUBTFUL AND IMPERFECTLY KNOWN SPECIES.

33. BRACHYTHECUM MIRABUNDUM C. M. & Kindb. Macoun, Cat. Can. Pl. 6: 194. 1892.

"Tufts large, very laxly cohering, nearly without rhizoids, silky or yellowish-green, faintly shining. Stem elongate, irregularly divided or prolonged into sciuroid-curved, obtuse branches. Leaves loosely imbricate, crowded, when dry subrugose, when moist patent, short decurrent, indistinctly auriculate, faintly plicate, from the concave, ovate and gradually acuminate base long-cuspidate; borders broadly recurved at least at one side of the nearly entire base to the involute and distinctly denticulate acumen; cells pale, elongate, and narrow, the alar subquadrate and not much wider than the other basal ones, all sparingly chlorophyllose; costa vanishing in the acumen. Capsule small, at the base indistinctly gibbous, narrow, cylindric, and curved; lid elongate-conic; pedicel very short, 0.5–0.8 cm., very faintly muriculate. Perichetial leaves nerveless, longer filiform-cuspidate, irregularly sinuolate, the point patent or arcuate; basal cells larger, rectangular; archegonia numerous, about 20. Monoicous."

"This species is allied to *Brachythecium rutabulum*, differs principally in the minutely muriculate and short pedicel of the small, narrow capsule, also in the leaves."

"On old logs in woods, Canaan Forks, Queen's Co., and Elmwood, King's Co., N. B., July, 1888 (J. Moser)."

Although I have had all of Professor Macoun's material of this species, I have not found any trace of the sporophyte and am unable clearly to differentiate this species from *B. rutabulum*. The stem leaves are more slender-pointed than is usual with *B. rutabulum* and are also somewhat plicate.

34. BRACHYTHECIUM PSEUDO-STARKEI Ren. & Card. Bot. Centralbl. **44**: 423. 1890.

"Dioicous, loosely caespitose, green; stem erect or ascending, flexuous, laxly pinnate, branches elongate, attenuate: leaves not close, patulous, ovate-lanceolate, plicate, acuminate, acumen long, sometimes tortuous; margin generally serrate all around; costa extending into the acumen; cells linear-rhomboidal, elongate, attenuate, alar lax, soft, quadrate, hyaline: not fruiting."

Washington. (Röll.)

Evidently aquatic, very lax and distantly foliate, with the habit of an *Amblystegium*. Related to *B. rivulare* and *B. rutabulum;* distinguished from both by its slender habit; from the first by its more slender-pointed leaves; from the second by having the leaves plicate and the branch leaves shorter-pointed. Stem leaves 1.8–2 by 1 mm.; middle branch leaves 1.4 by 0.8 mm.

35. BRACHYTHECIUM RÖLLII Ren. & Card. Bot. Centralbl. **44**: 422. 1890. Hedwigia, **32**: 263. 1893.

"Dirty or yellowish-green: stems soft, depressed, scarcely radiculose, subpinnate; branches elongate; flexuous: leaves ovate-lanceolate, decurrent, quite long and narrowly acuminate, faintly plicate; margin sinuate or denticulate, plane in middle, revolute at base and at acumen; costa reaching beyond middle to ⅔ length; cells narrow, elongate, linear, alar cells few subquadrate; evidently dioicous."

Vancouver. (Röll.)

The leaves of this species are shaped much like those of *B. plumosum*, but they are conspicuously dentate.

36. BRACHYTHECIUM CAVERNOSUM Kindb. Rev. Bryol. **22**: 86. 1895.

"Differs from *B. rutabulum*: leaves very concave, plicate,

recurved on both sides to the acumen; lower basal and alar cells small, green and not well defined; lid of the capsule longer apiculate or rostellate."

"Amer. Canada: White, com. Macoun."

37. BRACHYTHECIUM CALCAREUM Kindb. l. c.

"Resembles *B. intricatum* (*Hypnum* Hedw., *Brachythecium velutinum* (var.) Schimper) in the habit; differs from *B. lactum* (Brid.) Kindb. (non Schimp.), not occurring in Europe, in the entire stem-leaves, the larger alar cells and the shorter costa, from *B. salebrosum* also in the leaves curved or secund in dry state."

"Leaves crowded, long-acuminate and filiform-pointed, denticulate at the acumen or (the stem-leaves) nearly entire, more or less recurved, incurved falcate when dry, patent when moist; cells linear, the angular short, the alar ones few, much larger and hyaline. Stem-leaves with a broad base; costa short, mostly vanishing near the middle. Branch leaves narrow; costa nearly reaching to the acumen. Capsule small, arcuate; cilia not appendiculate; lid apiculate; pedicel smooth, about 1 centim. long. Tufts dense and radiculose, green and faintly glossy. Stem irregularly divided; branches not compressed; monoicous."

"Limestone rocks, Canada, Ottawa; 1892, Macoun."

38. BRACHYTHECIUM FITZGERALDI (C. Muell.) Ren. & Card. Rev. Bryol. **20**: 17. 1893.

Hypnum (*Brachythecium*, *Cavernularia*) *Fitzgeraldi* C. Muell. Flora, **70**: 224. 1887.

"Dioicous; tufts low, pulvinate, broad, yellow, loosely interwoven: stem with branches short, more or less parallel, slender, round-julaceous; branchlets very short, rather spreading, single: stem leaves closely appressed, when moist scarcely spreading with cordate base semi-circularly impressed, rather broad ovate, short-acuminate; more or less ventricose-concave on both sides of the narrow vanishing deeply canaliculate green costa; margin nearly plane, everywhere slightly denticulate; cells very narrow, long, pale yellow; alar cells many, small, hexagonal; fruit unknown."

Type locality, Florida. Collected by Fitzgerald. Specimens not seen.

No specimens of *B. Fitzgeraldi*, *B. cavernosum* or *B. calcareum* have been accessible and the original descriptions are quoted.

EXCLUDED SPECIES.

M. Cardot was the first to discover that *Brachythecium Donnellii* Aust. Bot. Gaz. 4: 162, is not a *Brachythecium* at all, but a *Stereophyllum*, closely related to *Stereophyllum leucostegium* (Brid.) from Mexico and the Antilles.

Professor Warming also communicated specimens of the Greenland plant referred to *Brachythecium trachypodium* (Funck) Br. & Sch. (*Fl. Gr. p. 336*). They are sterile and I can see no reason why they should be referred to *B. trachypodium* rather than to the closely related *B. velutinum*.

Specimens of Ren. & Card. Musc. Am. Sept. Exs. 108. (*B. latifolium* Lindb. Philib.), seem to me to be nothing but slender forms of *B. rivulare*. The stem leaves have the characteristic short acumination of that species. The plants do not agree either with Limpricht's description of *B. latifolium*, or with European specimens of that species determined by Brotherus and kindly communicated by M. J. Cardot.

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MEMOIRS

OF THE

TORREY BOTANICAL CLUB

Vol. VI No. 3

The Life History of Sphaerella lacustris (Haematococcus pluvialis)

By Tracy Elliot Hazen

(Plates 86, 87)

Sphaerella lacustris has often been employed in biological text-books (generally under the name *Haematococcus* or *Protococcus pluvialis*) as the lowest type of plant life. It is a type which is of particular value for elementary study because of its clear morphological characters and interesting development and also because this development may be regulated with comparative ease for class work.

Unfortunately, however, the treatment of the life history in the text-books is meagre and more or less marred by errors. Furthermore, although numerous memoirs and abstracts on this subject have been published, they are for the most part inaccessible to American students, or (especially in the case of abstracts) are so filled with misconceptions due to insufficient personal observation as to be of little value.

It was with the purpose of clearing up such errors, and of furnishing an account of the life history of this type that might be available for students, that the present study of *Sphaerella* was undertaken over two years ago.

In this report the first person has been frequently used because it was believed that the value of the account would be increased by thus clearly separating personal observations from previously published opinions.

I wish to express my gratitude to Professor L. R. Jones, of the

University of Vermont, and to Professor L. M. Underwood, of Columbia University, for their encouragement and aid in this study; and to the several botanists and zoölogists who have furnished information regarding the distribution of *Sphaerella* and especially those who have sent specimens for comparison.

GENERAL ACCOUNT

Sphaerella lacustris is usually found in urns or shallow pools formed in rock hollows which are either periodically filled with rain or supplied by water oozing from overhanging ledges. In these pools a blood-red crust composed of an infinite multitude of minute spherical cells covers every loose fragment of rock and the sides of the basin. The bottom is usually less densely coated, partly because the motile forms in seeking air and light are left at the edges of the water as it evaporates, and partly because the plants resting on the dirt accumulating at the bottom are more easily washed out by storms than those adhering to the solid rock.

If a portion of the red crust after being scraped off and dried for a short time is placed in a dish of water over night, it will be found in the morning that many of the cells are in process of division. During this process the cell mass, whose inner contents are entirely obscured by the blood-red pigment, increases in size and elongates and the outer layer of the thick cellulose cell-wall ruptures and allows the inner layer to be pushed out in a bladder-like expansion (Fig. 3). This gives space for growth and also facilitates the complete rupture of the membrane. Division proceeds until four, eight, or sixteen daughter-cells are produced. These daughter cells increase somewhat in size by absorption of fluid and usually I have found that they form very delicate cell-walls about themselves before leaving the mother-cell-wall (Fig. 5). Each develops a pair of cilia which may sometimes be seen fifteen or twenty minutes before the time of escape.

In some way a rent is made in the attenuated part of the mother-membrane, or less frequently it becomes softened and the daughter-cell bursting out rapidly swims off, ciliated end foremost. These zooids which are often angular and irregular in shape at first, soon become ovoid in consequence of the pressure from within and the tension of the cilia. The forward movement is ac-

companied by a constant rotation on the longer axis, from right to left, so that the path described is a spiral. The cellulose investment of the zooid, which was at first indistinct or invisible, soon becomes separated from the colored contents by an accumulation of water and appears as a delicate colorless bounding line (Fig. 6). Sometime later under favorable circumstances this cell-wall becomes still further distended and very delicate strands of protoplasm may be seen radiating from the colored mass to the cell-wall (Fig. 7).

Meanwhile a border of yellowish-green chlorophyl has been forming about the zooid replacing the outer part of the haematochrom. After a longer or shorter period of movement the zooids come to rest, usually adhering to some object by their cilia at first; the radial protoplasmic strands and cilia disappear, but often at the anterior end the sheaths which rigidly supported the bases of cilia remain, connecting the cell-wall with the protoplasmic body (Fig. 8). This quiescent cell may quickly divide again. The process, however, differs slightly from that of the original division as no appreciable distention of the mother-cell-wall occurs (Fig. 9); furthermore, the daughter-cells early develop cilia and move about within the mother cell-wall, often for half an hour or longer before going out; the daughter-cell-walls, also, are more likely to be well developed than those of the first generation. These zooids after breaking out increase in size forming more chlorophyl from the periphery inward like those of the first generation (Fig. 10). They also may arrive at a brief quiescent condition and repeat the process of division by which they were themselves formed (Figs. 11–14).

The time elapsing between these divisions is variable; sometimes the second generation is produced on the same morning as the first, but more frequently it appears that new generations are formed on successive mornings. How long this frequent division may continue has not been determined, but the colony may remain in the motile condition for three or four weeks.

At any point in the cycle, cells may go into a permanent resting stage. In that case, after the cessation of movement and disappearance of the protoplasmic processes (Fig. 16), a new thick cellulose coat is secreted close about the protoplasmic body (Fig. 17),

while the distended cell-wall of the zooid gradually softens and decomposes. At the end of a long cycle of generations the cells have only a small central globule of haematochrom, but as the permanent resting stage advances the haematochrom increases from the center toward the periphery, the color passing through shades of golden green and brown (Fig. 18), until the whole cell is of the blood-red color of the original individual (Fig. 19). Such resting-cells do not develop further—except to increase in size—unless desiccation or freezing takes place.

If these cells are dried or subjected to a low temperature, even for a short time, and then again supplied with water, a new cycle of development begins. This may proceed in just the same way as the former cycle; under certain conditions, however, which have not been fully determined, the red resting-cell may divide into a number (4, 8, 16, 32) of microzooids which, unlike the megazooids, swarm actively within the mother-cell-wall for some time before coming out (Fig. 20). These microzooids shoot through the water in a very erratic manner; their shape is narrowly cylindrical or fusiform (Fig. 21), or somewhat ovoid in case their movement is less rapid; they have no visible cell-wall and their period of motility is much shorter than that of the megazooids. Many microzooids soon die, others come to rest, secrete a cellulose investment and probably grow into normal resting cells (Fig. 22).

HABITAT AND DISTRIBUTION

Sphaerella lacustris is reported as very common and widely distributed in Europe, where it is found from Scandinavia to Venice. It seemed quite probable, therefore, that investigation would prove an equally wide distribution in America, even though Wolle, in his Fresh Water Algae of the United States, was unable to furnish any information as to its occurrence here.

Inquiry among leading botanists and zoölogists has shown that the alga is distributed from Vermont to Texas and from Massachusetts to Nebraska (Professor C. E. Bessey) and probably farther west. All the specimens mentioned below, obtained from widely separated stations and from different types of habitat, I have kept under observation in cultures until there was not the slightest doubt that all were referable to the one species, *Sphaerella lacustris*.

I first collected this alga at Burlington, Vermont, in hollows of a red sandstone quarry where it had been obtained during several seasons for the use of classes in biology at the University of Vermont. I also found it in similar hollows of limestone ledges in the vicinity. I have made a careful study of these pools and found that in all cases they were small basins filled by rain or water oozing from the ledges above, but so shallow as frequently to be dried up during the summer. Similar but deeper basins side by side with these contained *Hydrodictyon* and *Spirogyra*, but no *Sphaerella*. The apparent reason was twofold: (1) The deeper pools did not furnish the condition of frequently alternating wetness and dryness which culture experiments show is favorable for prolonged vitality, and (2) If the *Sphaerella* did cover the bottom of these deeper basins as they dry up in the hottest weather, when they are re-filled by a heavy rain the cells would be so deeply buried as to be unable to get sufficient air for development.

Professor G. H. Hudson has sent me *Sphaerella* material from Plattsburgh, New York, where he collects it in hollows of an abandoned quarry in Chazy limestone and in a pot-hole of the Saranac River; he says "these pools become dry in summer and the stones look as if red paint had been spilled upon them."

Sphaerella is rather abundant in rock hollows near streams and about the lake at Ithaca, New York. Material collected there in December by Professor F. A. Waugh divided so rapidly that after two weeks I found all the zooids were of a comparatively small size.

Professor W. L. Bray has sent me material from Austin, Texas, where it is found in a pond which lasts almost all the year, forming part of a creek in winter, and also in creek pools near the Colorado River. Chodat ('97) finds that *Haematococcus* is present though not abundant even in the plankton of Swiss lakes, but he considers that in such cases it has been washed out of the rock basins which form its natural home along the shore.

I have *Sphaerella* material obtained in cemetery urns in Chicago by Professor C. B. Atwell, and in Baltimore by Mr. H. F. Perkins. Professor E. G. Conklin has also found it in such urns in Delaware, Ohio, Evanston, Ill., and Philadelphia. A note in Dr. Harriet Randolph's "Laboratory Directions in General Biology" suggests that the occurrence of *Haematococcus* in marble urns may be due

to the lime in the water. It seems more probable, however, that it is simply because the urns provide the conditions of light, aëration, and evaporation demanded by *Sphaerella*. Further support of this view is found in the fact that Alexander Braun ('51) records the occurrence of this alga not only in basins of granite and sandstone, but also in holy water urns of iron and in a tin roof-gutter.

Dr. H. M. Richards has obtained *Sphaerella* from dripping rocks above high tide at Nahant, Mass. I have found it in a similar place in New York under an overhanging cliff, where the supply of moisture frequently fails even in winter.

This alga was distributed as *Haematococcus lacustris* (Girod) Rostaf. in the Phycotheca Boreali Americana (no. 114). The material was collected at Bridgeport, Conn., by Mr. Isaac Holden, who informs me that it "formed a soft coating on the vertical face of rough-hewn stones of the abutment of the dam, where the water percolated through the crevices and trickled down the surface. It was very abundant for several seasons, but has not appeared lately. On sloping and horizontal rocks, which had become dry and exposed to the sun, I have seen it forming a closely adherent thin red film, which could not be removed without difficulty." I have scraped such a red coating from a sloping ledge at Richmond, Vermont, which was washed by a very small spring in summer. At certain times, after an increase in the volume and force of the water, much less of the *Sphaerella* was to be seen.

Some years ago the fountain in the college yard at Cambridge, Mass., was green with zooids of *Sphaerella* for a time in the spring, but Dr. Farlow informs me that last year none could be found.

It will be noticed that in the last three localities conditions were unfavorable for the persistence of an organism which may be so easily swept away by an unusual force of water. We are, therefore, justified in concluding that the small rock basins provide the most secure home for *Sphaerella*.

THE RESTING CONDITION

In the typical resting-cells of *Sphaerella* which vary from eight to eighty microns in diameter, the only structure visible is the spherical mass of protoplasm closely enveloped in a thick membrane of cel-

lulose. (Fig. 1.) By typical resting-cells are meant the entirely red cells, in which the vital processes are at a minimum; for often non-motile cells are found, in which considerable chlorophyl and pyrenoids and a nuclear area are seen, but these cells represent simply a transition between the motile condition and that of complete rest, or a state of non-motile vegetative propagation.

The nucleus and pyrenoids are, indeed, present in the typical resting-cells, but are hidden by the haematochrom, which, partly in solution in oil drops, and partly in micro-crystalline form (Zopf, '95), penetrates the whole mass of protoplasm. That some chlorophyl also is present, even in the pure red cells, is indicated by the researches of Englemann and Zopf.*

REPRODUCTION

Reproduction is accomplished in three ways:

1. By the formation of large motile daughter-cells or megazooids.
2. By the formation of non-motile daughter-cells.
3. By the formation of smaller motile-cells or microzooids.

THE FORMATION OF MEGAZOOIDS: THE FIRST GENERATION

Alexander Braun ('51) apparently was the first to note that the production of zooids under natural conditions occurs early in the morning. The time varies with the season of the year. In the summer the zooids leave the mother-cell-wall so early that I have found it hard to observe the act even by examining the material before sunrise. In early spring and in autumn division does not often take place in the open air before seven or eight o'clock. This variation is undoubtedly to be explained by the difference in the time of sunrise; but that the escape of the megazooids is due not to the atttainment of a certain intensity of light, but rather to the conditions of temperature is indicated by the fact that megazooids may be produced in absolute darkness. When dry material is placed in water in the morning and kept dark for a few hours, megazooids will be formed in abundance. At a temperature of 22°–26° C. five or six hours is sufficient time, while at 16°–20° six to nine hours may be required.

* See the section on the coloring matters.

In cloudy weather one is likely to find cases of division at almost any hour of the day if the temperature is favorable. This fact indicates that the light which promotes photosynthesis hinders the resorption of materials in preparation for division.

The time required for the formation of megazooids after the actual beginning of division varies with different conditions of light and temperature. In all cases that I have observed continuously under the microscope, the process has occupied at least an hour, often several hours. But there is good reason to believe that light retards the process of division, even as it is unfavorable to the preparatory process, for in completely darkened cultures I have repeatedly found that nearly all division is completed within an hour after its beginning is observed, while in cultures left in ordinary light dividing cells will be found for several hours.

Alexander Braun ('51) says that even before the beginning of division the red color begins to be replaced by a yellowish-green layer from the periphery inwards, but I have not found this to be the fact except when division is delayed, and in case of cells which have not gained the entirely red color of typical resting-cells. When division is accomplished promptly red cells produce red zooids.

After the first cleavage which is transverse, the division follows no constant rule; the second cleavage, though in a plane perpendicular to the first, may begin at both poles simultaneously or division may be completed in one hemisphere before it begins in the other. Often when four daughter-portions appear to be completely formed they divide again so as to form eight zooids, but more frequently when eight or sixteen zooids are to be produced the division is so irregular that it cannot be followed easily, or the mass may even appear to break up all at once into numerous daughter-cells.

Dangeard ('88) suggests as an explanation for such cases that possibly the resting cells contain several nuclei, and he also thinks that when more than four daughter-cells are formed, the reason may be that the mother-cells have been for some cause prevented from dividing at the normal point and have continued to increase in size. This explanation does not appear to me quite sufficient, for not infrequently eight or sixteen zooids are produced by cells no larger than those which produce four or eight.

I have been unable to find a record of the production of more than eight megazooids in one cell and it has even been stated in some of the text-books that when more than four daughter-cells are produced they are to be regarded as microzooids. Nevertheless I have frequently found in one cell-wall sixteen typical megazooids, each possessing a distinct cell-wall and in point of size equaling and sometimes surpassing the individuals produced in groups of four and eight (Fig. 23). Division often begins before there is any appreciable increase in the size of the cell-mass (Fig. 2), but very soon so much fluid is taken in by endosmosis that the cell-wall is distended until its outer layer is ruptured or softened and an inner layer is pushed out, doubling the original space (Fig. 46). That the amount of distention is not dependent on the amount of increase in the size of the daughter-cells is indicated by the fact that often much more space is formed than they can fill (Fig. 5). Probably this distention is of service also in rendering the membrane thin enough so that it can be ruptured easily when the zooids escape. Generally, however, this part of the cell-wall remains considerably rigid, for when, as sometimes happens, only a small slit is made for the escape of the zooids they are unable to stretch it, but are themselves compressed into a dumb-bell shape in squeezing out (Fig. 34).

It is said by both Cohn and Braun that the daughter-cells possess no cell-wall at the time of escape from the mother membrane. Parker ('93) states that the cell-walls and cilia of megazooids are formed sometimes before, sometimes after they leave the mother-cell-wall. In a great number of cases of division into four, eight and sixteen daughter-cells, the cell-walls have been distinguishable at the moment of escape, if not some time before; in other cases only the deceptive line of color refraction can be distinguished outside the boundary of the protoplasmic mass, but so delicate a structure might easily escape observation under ordinary objectives. As for the cilia it is difficult to imagine how the zooids could swim away from the mother-cell-wall if they were not formed before the escape.

THE FORMATION OF MEGAZOOIDS IN THE LATER GENERATIONS

The second generation is normally produced after the zooid has passed through a very short quiescent stage, which is by no means equivalent to the regular resting stage since no thick cell-wall is formed.

Most frequently in all generations of megazooids after the first, I have found only two daughter-cells produced, but on two occasions I found that nearly all the megazooids of the second generation were produced in fours (Figs. 9, 52). Braun ('51) says this is the usual number and that more rarely two or eight are formed.

It is almost impossible in the later stages unless they are produced in drop cultures, to say certainly whether zooids belong to the second or a later generation, for the process of formation is similar in all cases after the first generation.

Braun ('51) states that in the later generations division often begins before the zooid comes to rest. I once found such a case where the mother-cell was swimming rapidly by means of its cilia which were still attached to one of the daughter-zooids, although each of these was moving independently by means of its own cilia (Fig. 38). Perty ('52) says that the cilia of the mother-cell continue to move until the protoplasm breaks up into the daughter-cells, and Cohn ('50) states that the movement may continue even after the cilia are detached from the daughter-cells; but in cases where I have seen these detached cilia remaining they have been quite rigid (Fig. 37), and the movement of the cell-wall was caused simply by the motion of the daughter-zooids within.

Perty ('52) has described a figure which he says represents division of a motile cell where the anterior part of the cell-wall is divided by constriction into two beaks, each of which possesses a pair of cilia, while the posterior part is still entire. This, however, must be considered a monstrosity, for normally only the protoplasmic part of a zooid is affected by division.

VEGETATIVE DIVISION

At the time of his first publication on *Protococcus*, Cohn ('50) undoubtedly thought that the production of non-motile cells from resting cells formed a regular part of the cycle of development; he indicates that the contents of the resting-cell divide into two

parts, each of which becomes invested with a cellulose wall; each of these daughter-cells in turn forms two cells, all four become clothed with cell-walls and remain enclosed in the enlarged membrane of the original cell; each of these four cells may divide again to produce a third generation of daughter-cells which may become motile. In a later supplementary description, Cohn ('54) illustrates the development of *Chlamydococcus* by figures showing the formation of the zooids in a manner esssentially like that which I have observed (Figs. 2–5, 46–48), that is by successive divisions without the formation of cell-walls in the intermediate stages.

Later still Cohn * said there was need of further proof of the development of resting-cells directly from resting-cells (*Selbsttheilung*) which he had first described.

Braun ('51) asserted that a vegetative division does take place, but not as a part of the regular cycle of development previously described. He found that where the cells are kept simply moist and exposed to the air, as is the case under natural conditions, especially in the milder intervals of winter and on the moist edges of rock basins at other seasons, the cells multiply either by simple division or by double halving, but the daughter-cells thus formed do not slip out of the mother-cell-wall; they gradually acquire thick, close cell-walls, while the mother cell-wall expands and disappears. By the frequent repetition of such a process masses of cells become pressed together so that thick crusts of cells bounded by flat surfaces may be formed. This vegetative division is very rarely found in cultures in the laboratory, because of the difficulty of producing artificially the conditions which foster it.

Cohn ('50) notes that temperature is one of the factors which determine whether resting or motile cells shall be produced. On one occasion I found in a glass jar kept on a window ledge a large number of red cells which had developed daughter-cells indistinguishable from ordinary zooids in form. None of them, however, became motile (Fig. 49) and the only possible explanation was that after division had begun a sudden drop in the temperature prevented the daughter-cells from becoming zooids.

I have frequently examined the *Sphaerella* growing on a moist

* Cohn and Wichura. Ueber *Stephanosphaera pluvialis*. Nov. Act. Acad. Caes. 26[1]: Nachtrag. 23. 1857.

rock during the present winter. Sometimes I have found large, scattered cells, at other times numerous clusters of small cells clearly indicating recent division, but never any zooids, even though at times there was sufficient water for movement. The reason here again appeared to be that the more abundant water supply was accompanied by so low a temperature that the motile state was not acquired. Material collected from the rock at such times and placed in a slightly warmer atmosphere produced abundant zooids (Figs. 23, 45–48).

Rostafinski ('75), indeed, reports that when he placed vessels containing many zoöspores outside a window at a temperature between 6° and 2° multiplication and production of zoöspores continued in normal fashion; when during the night the temperature fell and a mass of purple ice was formed, he found after slow thawing, a large number of zoöspores which showed active vibratory movements. I have repeatedly attempted to confirm these results but I have never been able to discover zooids produced at a temperature lower than 12°–15° C. I have always found that if a vessel containing zooids is slowly frozen the zooids may still continue to live under a crust of ice where the temperature of the water is about 1° C., but when actually imprisoned in ice they invariably die. Cohn ('50) also found that motile cells were killed by freezing. It is quite possible that Rostafinski thawed his cultures so slowly that new zooids were formed.

I have never found any evidence of any other type of vegetative propagation than the endogenous division already described. Cohn's figure 15 which has been copied by Bennett and Murray and others as the palmella-condition of *Protococcus* may be interpreted as a case of endogenous division in which the daughter-cells have been pressed together so as to be bounded partially by flat surfaces, while the mother-cell-wall has disappeared.

It is to be concluded then, that vegetative division plays an important part in the multiplication of *Sphaerella lacustris*, but that the process does not differ from that by which zooids are produced except that the motile condition is not acquired because of insufficient water, aëration, or temperature.

THE FORMATION OF MICROZOOIDS

Alexander Braun ('51) was apparently the first to distinguish accurately the microzooids from megazooids. He found that during the latter stages of the cycle of generations many cells, instead of producing only four daughter-cells, continued to divide so as to produce a mulberry-like mass which was finally broken up into sixteen or thirty-two minute cells. These "microgonidia" then began swarming actively within the mother-cell-wall and finally burst out; they were of longer shape than the large swarmers, only about 6.6 microns long, of yellowish green color with reddish ciliated points; they did not increase in size or acquire a perceptible membrane but most of them died after coming to rest; others turned into little red globules whose further development was uncertain. My own observations as to the character and manner of formation of the microzooids agree with Braun's account. Sometimes a zooid which has recently come to rest appears to be forming four megazooids but further watching discloses eight or sixteen active microzooids (Figs. 24, 25). I have, however, found microzooids developed most abundantly from red resting-cells which before being dried had been subject to unfavorable conditions (Fig. 20). The shape of microzooids varies from fusiform or cylindrical when they are most active to ovoid when they are more sluggish. Their rate of movement, nearly always more rapid than that of megazooids, is perhaps to be explained by the fact that their cilia are as long as those of megazooids while their bodies are much smaller. The color varies with that of the mother-cells from which they are produced, but usually when considerable of the yellowish green color is present the red pigment does not form a central mass as in megazooids but is collected at the anterior end (Fig. 28) or in a central girdle (Fig. 26). The movement of one brood of microzooids appears never to continue longer than through one day, though a new brood may be produced from other resting-cells in the same vessel on successive days for a week. Generally most of the microzooids die but sometimes after coming to rest they acquire a thick cell-wall and gradually increase in size as they grow red. I have been unable to develop them further.

By supplying nutriment to these red globules in Van Tieghem cells, Rostafinski ('75) succeeded in causing them to increase to

the size of the ordinary resting condition, and then by transferring them to pure water obtained megazooids through the ordinary mode of division. Rostafinski discovered no conjugation and concluded that *Haematococcus* is an asexual plant. I have frequently found forms presenting the appearance of two microzooids fused at their anterior ciliated ends but no actual meeting has been observed and such forms may be explained as monstrosities resulting from incomplete division.

From the conditions of their formation, however, it seems to me that the microzooids must be potentially gametes. Their formation does not appear to depend entirely on the conditions which affect the water at the time the microzooids are produced, for megazooids may be produced in the same cultures at the same time. On the contrary, when, from lack of nourishment or of a sufficient temperature, the resting-cells are unable to grow to the usual size and strength, microzooids are produced much more abundantly. I have found particularly that when cultures containing *Sphaerella* are allowed to evaporate more rapidly than under natural conditions, the resting-cells collected on the sides of the vessel, if again supplied with water, nearly always produce microzooids in countless numbers. I have also obtained only microzooids from certain material collected (in Burlington) on rocks where it had been frozen most of the winter, but which, at milder intervals, had probably been able to produce small resting-cells. Material collected from the same place in May and June produced megazooids.

In addition to previous conditions of growth, at the time of division light seems to be favorable for the formation of microzooids. Sachs states that when a certain light intensity is reached swarmspores will break forth. I have rarely been able to produce microzooids in cultures kept dark, as I have megazooids, but the same material, when subjected to a preparatory darkness over night and allowed to receive the natural gradual increase of light in the morning, produces abundant microzooids. On one occasion I found a recently motile cell in which division was beginning at nine o'clock in the evening; I kept it under observation for two hours, during which sixteen micro-daughter-cells were formed; but they did not become motile, perhaps because the light (from an ordinary student-lamp) was not sufficiently intense.

Since, therefore, microzooids of *Sphaerella* are formed under the conditions which Klebs found were necessary for the production of the sexual cells in the closely related genus *Chlamydomonas*, viz., lack of nutriment and presence of light, the assumption that they are potentially gametes appears to be justifiable. If no conjugation really takes place, its absence may be accounted for by the fact that in the successive conditions of activity, slow growth, and rest, a sufficient opportunity for rejuvenescence is found.

THE SO-CALLED CONJUGATION OF MEGAZOOIDS

Velten ('71) has described and illustrated with considerable detail a process which he considered conjugation of megazooids. This does not differ essentially from cases which I have frequently observed. Two zooids are found attached together by their posterior ends (Fig. 42) and the content of one cell passes over into the other (Fig. 43), the cilia of each cell meanwhile keeping up active movement, at least for a part of the time. Finally a spherical zygote is produced which does not differ from the ordinary resting-cell (Fig. 44), the fate of which Velten did not learn. I have not been able to get any further development from such a product of fusion by cultivating it in a Van Tieghem cell.

Rostafinski ('75) rejects Velten's interpretation of this phenomenon on the ground that it is contrary to all previous observations, in that not microzoöspores, but megazoöspores conjugate, and by their posterior ends instead of by the ciliated points. So far Rostafinski's objection holds good ; but when he goes on to say that Velten's conjugation is to be interpreted as a case of a parasitic monad swallowing a zoöspore of *Chlamydococcus*, I think he is entirely wrong, for the cases (*cf.* Figs. 39–44) I have observed admit of no such explanation. On the contrary, I think they are cases in which the original division was incomplete and the two-headed monster, after struggling in vain to complete the separation, fuses again to form one cell. This interpretation receives support from one case where I observed the actual formation of such a monstrosity. When the division had reached a stage similar to that shown in Fig. 47, the mother-cell-wall burst and one perfect zooid escaped while the rest of the cell-content issued forth in the form of a large ciliated mass with a smaller

one attached, each part being invested with a cellulose membrane. Probably the premature rupture in this case was due to the pressure of the cover-glass; the double zooid, however, was vigorous enough to swim about actively after more water was supplied. Very frequently dumb-bell shaped pairs are found which are ciliated at both ends (Fig. 40) and which do not fuse but sometimes do succeed in becoming separate. More rarely three- or four-headed monstrosities of a similar nature are found (Fig. 41).

Velten said that these conjugating pairs were always to be found in glass vessels placed in sunlight. I have found these malformations more abundant under such conditions, but sometimes also even in darkened cultures.

THE ALLEGED AMOEBOID CONDITION

White ('80) has described what he thought might be the transformation of *Sphaerella* (*Protococcus pluvialis*) into an amoeboid condition. He found amoeboid organisms containing in the center a colored mass like that of *Sphaerella*, and he supposed that "the structureless envelope becomes the homogeneous part of the *Amoeba* while the granular center becomes the granular *Amoeba*." He says further, "I have to-day seen an *Amoeba* with a well-defined homogeneous circular zone having within it a pale green area with the red oil spot but to one side rather than centrally situated, evidently a *Protococcus* undergoing change to an *Amoeba*. Now the well-defined circle has broken up into the usual amoeboid projections and it has passed beneath some decayed vegetation and become invisible."

Dangeard ('88) discredits this amoeboid state, and there can be little doubt that it represents the case of an *Amoeba* digesting a zooid of *Sphaerella*. I have several times found such cases. I once observed a rhizopod (*Actinophrys*) devour eight megazooids in a short time; the green pigment was quickly digested, the red more slowly.

SPECIAL MORPHOLOGY OF MEGAZOOIDS.—THE CELL-WALL AND SHEATHS OF CILIA

The cellulose character of the cell-wall was doubted by Busk ('53). Cohn ('52), however, states positively that he succeeded in

demonstrating the cellulose character of the cell-wall, particularly in the case of the motile cells. The test is not always convincing, but by using rather strong sulphuric acid followed after a few minutes with dilute iodin according to Cohn's directions, I have obtained a blue color which could leave no doubt in one's mind. Although the test is less satisfactory with the resting-cells, probably because they are somewhat coated with a gelatinous substance, yet even here the cellulose reaction is unmistakable.

The sheaths which surround the bases of the cilia (Figs. 15, 16) usually disappear in the distortion produced by the action of sulphuric acid, but there can be little doubt of the truth of the statement by Kerner* that they consist of cellulose, for they do not take up protoplasmic stains.

THE RADIAL STRANDS OF PROTOPLASM

The use of iodin or other proper stains demonstrates very clearly the protoplasmic character of the threads which radiate from the central colored mass. These threads often appear to end in a slight enlargement without coming into connection with the cellulose wall, but more careful examination often shows that they are finely branched at the end (Fig. 15) and probably these branches anastomose to form an exceedingly fine network close to the cell-wall. This structure is so delicate, however, that I have been unable to demonstrate it by staining or plasmolysis.

The protoplasmic strands are not always visible, even in mature zooids. Zacharias† intimates that zooids showing this structure are generally found in the stagnant water of old cultures, and suggests that they exhibit a strong approach to *Amœba*-like organisms. I have found, however, that even young zooids in fresh cultures when kept in sunlight, show the threads well developed, so that it appears to be a condition accompanying vigorous assimilation and growth.

THE CHROMATOPHORE AND PYRENOIDS

Cohn ('50), considering the colored protoplasmic mass homologous with the "primordial utricle" of plant cells, applied to it the

* Kerner-Oliver. Natural History of Plants, 2: 630. 1895

† O. Zacharias. Experimentelle Untersuchungen über Pseudopodien-Bildung. Biol. Centralb. 5: 261. 1885.

name "primordial cell." Taking into account the radial strands of protoplasm and the network which they probably form, this term is hardly suitable. The protoplasmic mass must be regarded as the single chromatophore (Vines, '86, Bütschli, '84). This chromatophore, at first solid, may in the later stages become vacuolated so as to present the form of a hollow green sphere inclosing the red nuclear globule (Fig. 30). Frequently the chlorophyl of this hollow shell becomes reduced in places so that it appears to be pierced with holes (Fig. 15). It is such conditions which have given rise to the statement that the zooids contain several chromatophores.

The extent to which the haematochrom is changed into chlorophyl appears to depend on the conditions which ordinarily affect the production of chlorophyl. The zooids do not need the haematochrom but much of it may be retained for a day or two if the temperature is not favorable for the formation of chlorophyl. Light is apparently not so essential a factor as warmth, for zooids kept in the dark may develop considerable chlorophyl. Under such circumstances it is noticeable that the haematochrom is more scattered and mixed with the chlorophyl, but when these zooids are brought into the light the haematochrom soon becomes collected into a central globule.

When the conditions are favorable for the formation of chlorophyl the haematochrom may disappear altogether in the later stages (Fig. 32); it never seems to have the character of the red "eye-spot" of other genera, but gradually fades out.

In the green chromatophore are embedded several (4–8) pyrenoids. These were called *Chlorophyllbläschen* by Cohn ('50), who expressed doubt as to the presence of starch in this alga. Braun ('51) recognized their true nature in relation to starch formation. Frequently the presence of starch cannot be demonstrated by application of iodin, but the test is successful if the culture has been furnished with sufficient light and aëration. The pyrenoids are especially prominent after freezing; they then show a clear nuclear spot in the center.

A CONTRACTILE VACUOLE NOT PRESENT

The presence of a contractile vacuole in this organism is alleged by Cienkowski* and Bennett and Murray ('89). They are, however, undoubtedly in error on this point, for nothing of the kind has been recorded by the men who have become thoroughly acquainted with *Sphaerella;* in fact, the existence of a contractile organ is expressly denied by Cohn ('54).

There is also one of Bütschli's figures (*Pl. 43. f. 9a*) representing a contractile vacuole in *Haematococcus lacustris*—a figure which has been copied by Hansgirg ('88) as *Sphaerella lacustris*, by Parker ('93) as *Haematococcus lacustris*,† and by Lankester as *Haematococcus palustris!* in the article Protozoa in the Encyclopaedia Brittanica. The figure which has caused all this confusion was copied by Bütschli from Stein's figure (*Pl. 15. f. 58*) of *Chlamydococcus fluviatilis* Stein, and was never intended to represent the species to which Bütschli applied it. It appears to me, indeed, that Stein's figure does not even represent a *Chlamydococcus* (*Sphaerella*) for it has the red eye-spot, contractile vacuole, prominent nucleus‡ and single large pyrenoid which are characteristic of *Chlamydomonas*, and in its development also, Stein's species is like this genus rather than like *Sphaerella;* it corresponds very closely to the *Chlamydomonas rostrata* described by Cienkowski in the article above referred to, a form which I have collected several times near New York.

THE COLORING MATTERS

Cohn ('50) first described the pigment of the resting-cells as a scarlet red oil, soluble in alcohol and ether, and turned blue by iodin. Some years later Cohn ('67) gave to this pigment the name haemato-

* L. Cienkowski. Ueber einige chlorophyllhaltige Gloeocapsen. Bot. Zeit. 23: 25–27. 1865.

† Parker was evidently unaware that *Haematococcus lacustris* and *H. pluvialis* are synonyms, for he remarks that a contractile vacuole, though absent in *H. pluvialis*, is present in *H. lacustris*. This confusion might have been avoided had he noticed the footnote in which Bütschli accepts Cohn's objection to the name *H. lacustris* and re-adopts *H. pluvialis*.

‡ The nucleus is never distinguishable in living zooids of *Sphaerella* and it is even difficult to demonstrate it by simple staining processes. I have met with success by using osmic acid and carmine as suggested by McNab. Ann. and Mag. Nat. Hist. 12: 124. 1883.

chrom and further defined it as a substance different from the coloring matter of the red algae (which is soluble in water) and the purple pigment found in many Oscillatoriaceae. He inferred that haematochrom is a substance very closely related to chlorophyl since at certain times it appears to be built up directly into chlorophyl; he also supposed that the coloring matter found in *Trentepohlia* and the red "eye-spots" of zoöspores was haematochrom.

Rostafinski ('81)* declared that *Haematococcus* in the snow-fields of the Alps never grows green, but the green appearance sometimes ascribed to it is due to a species of *Chlamydomonas*; since, however, the red cells increase rapidly, he thought it was clear that their plasma could assimilate without chlorophyl and without organic matter in solution. Rostafinski, furthermore, extracted the red pigment (apparently from *Trentepohlia*) and finding that it had a spectrum similar to that of chlorophyl and also became green when exposed to light, he concluded that it was a reduced chlorophyl, and in order to indicate this relationship suggested for it the name *chlororufin*.

During the next year Engelmann ('82) made careful investigations to confirm or overthrow Rostafinski's assumptions. By means of his bacterial method† he proved that the pure red cells are able to decompose carbon dioxid under the influence of light, but the reaction was stronger in the greener cells. Next, by research in the microspectrum, Engelmann found that even in the case of the red cells the rays most effective in photosynthesis are those which his previous experiments‡ had shown to be the most effective in the case of green cells, viz., the red rays between *B* and *C*. Finally he found that the pure red cells gave a strong continuous absorption from the yellow to the violet end of the

* It should be noted that Rostafinski considered the "red snow" species *Sphaerella nivalis* (Bauer) Sommerf. identical with his *Haematococcus lacustris*

† A drop of water filled with red cells of *Haematococcus* was mixed with a drop containing many active bacteria and mounted under a cover-glass and sealed with vaseline. When placed in the light, after a few minutes most of the red cells were surrounded by swarms of bacteria eagerly seeking the oxygen given off by the cells through the decomposition of CO_2 under the influence of light acting on the coloring matter. In the dark the movement quickly stopped.

‡ T. W. Engelmann. Über Sauerstoffausscheidung von Pflanzenzellen im Mikrospectrum. Bot. Zeit. 40: 417–426. 1882. (See Vines, Physiology of Plants, 225–257. 1886.)

spectrum, and only a feeble darkening in the position of the characteristic chlorophyl band between *B* and *C*; while the more the cells changed from red to green, the stronger was the absorption between *B* and *C*, and the feebler that in the yellow and green. Engelmann's experiments therefore quite justified his conclusion that the photosynthesis in the red cells of *Haematococcus* is due not to the red color but to the presence of chlorophyl mixed with it.

The experiments of Engelmann with living cells have been confirmed by Zopf's researches on the extracted coloring matters. Zopf ('95) collected about a kilo of red *Haematococcus* and extracted the coloring substances with warm absolute alcohol. From this alcoholic solution he separated* a chlorophyl solution, a yellow pigment solution, and a red pigment solution. Zopf also extracted the so-called haematochrom of *Trentepohlia* but found that it formed a yellow solution similar to the yellow solution from *Haematococcus* if not identical with it. This yellow pigment, or carotin, is to be sharply distinguished from the red pigment; it constitutes only a small element in the coloring matters of the red cells of *Sphaerella*. The red pigment forms a brick- to blood-red colored combination with alkalies and alkaline earths; the solution in alcohol, ether, and petroleum-ether, as well as the evaporation residue, shows the same red tint; and the spectrum gives a single but broad absorption band in the green and blue, strongest in the line *F*. The yellow carotin of *Trentepohlia*, on the other hand, forms no combination with alkalies and alkaline earths; the extracts in alcohol, ether, and petroleum-ether as well as the evaporation residue are yellow; and the spectrum shows two narrow absorption bands in the blue and indigo.

Zopf thus shows that the assumption by Cohn ('67) and Rostafinski ('81) that the reddish pigment of *Trentepohlia* and the haematochrom of *Haematococcus* are identical was not warranted by facts. He considers the yellow carotin one of the eucarotins, pigments which are carbohydrates: the red pigment, for which the name haemotochrom may still be used in the restricted sense, is a repre-

*The raw alcoholic mixture was treated with a solution of caustic soda and the chlorophyl formed a combination with sodium the yellow pigment became free and the red combined with sodium. A separation was then effected by taking advantage of the fact that the chlorophyl-sodium is solub'e in water, the yellow pigment easily soluble in petroleum-ether and the red less soluble in petroleum-ether.

sentative of the carotinins, a class of pigments which show much greater stability; the carotin of *Trentepohlia* keeps its color in the dried state for only two months at the longest, while the haematochrom retains its color for years.

It appears to me not unreasonable to conclude that in its chemical nature haematochrom is closely allied to chlorophyl in spite of the fact that it gives the starch reaction with iodine.

FUNCTION OF THE HAEMATOCHROM

When we consider what the value of haematochrom may be to *Sphaerella* we come to a very perplexing problem. Haematochrom is especially an accompaniment of diminished vitality, and it is, therefore, mainly in connection with the resting stage that we must study its function. Nevertheless, the red color of *Sphaerella* must have a greater significance, it seems to me, than that found in the winter spores of other fresh-water algae, since it forms so much more constant and permanent a feature.

It has been very generally supposed that red coloring matters have some relation to light. MacDougal* thinks the red color substance of *Haematococcus* is a protection against the disintegrating effect of light on chlorophyl and protoplasm. That it may serve such a purpose in the pure red cells is quite probable, especially as I have nearly always found only such cells in the pools which are exposed to the glaring sun, even though they were filled with water, while on the rock in New York, scantily supplied with water but turned away from the sun, I have generally found many green cells.

In the partly green cells, as Engelmann has remarked, the red color can have little effect as a protective screen, since it occupies a central position in the cell, and the supposed disintegrating rays which it absorbs, viz., those from the green to the violet end of the spectrum, must pass through most of the chlorophyl and protoplasm before they are acted on by the red pigment.

The researches of Kny and of Kerner show that red coloring matters probably play an important rôle in converting light rays into heat. It is entirely possible that the haematochrom serves this pur-

* J. C. Arthur and D. T. MacDougal. Living Plants and their Properties, 185. 1898.

pose both in the greener and in the pure red cells. In the case of the red cells of *Sphaerella nivalis** especially it appears that such a function would be of great value, since the heat created would be available in melting the snow. Moreover, I have been struck with the fact that, in cultures kept under precisely the same conditions in the laboratory, material from milder climates, *e. g.* from New York and Baltimore, habitually develops more chlorophyl than material collected in places which are frozen a large part of the winter, as at Burlington, Vermont, and Plattsburgh, New York.

From the fact that the haematochrom is wrapped about the nucleus, and except in rare cases (Fig. 33) envelops each daughter-nucleus during the process of division, it might be suspected that it has some food value.

The key to its most important function, however, may lie in the chemical nature of the haematochrom. It possesses much greater stability than chlorophyl and therefore probably plays an important part in enabling the cells to endure adverse circumstances. I have found that zooids furnished with considerable haematochrom are less quickly destroyed by sudden changes of light and temperature than greener ones.

IRRITABILITY OF ZOOIDS

The zooids of *Sphaerella* furnish very interesting material for studies in sensitiveness. In general they are strongly attracted toward light so that, when they are cultivated in glass vessels, the margin of the water nearest the light will be colored red or green by the accumulation of zooids in that part, while very few will be found in other parts of the vessel.

This light-seeking tendency, however, varies somewhat with circumstances. Strasburger ('78) found that the young zooids would swim towards a light from which they would move away when older, and that though zooids sought the light at a temperature of 16°–18°, they shunned light of the same intensity at 4°. I have found, on the contrary, that when reduced gradually

* Dr. J. G. Hunt (Am. Nat. 9: 575. 1875) states that the coloring matter of "red snow" leaves unchanged the red, orange and yellow portions of the spectrum but entirely absorbs the violet portion. It may be assumed, then, that the coloring-matter of *Sphaerella nivalis* is identical with the haematochrom of *S. lacustris*.

from a temperature of 18° even to the point where the surface of the water became coated with ice the zooids all the time sought the lighter side of the glass dish. Some of the variations in experiments with zooids may be due to currents in the water, for Sachs ('76) was able to produce many of the phenomena exhibited by zoöspores by means of minute oil globules.

Microzooids are usually more positively attracted to light than megazooids, so that in cultures where both are present, as Sachs ('76) has noted, the microzooids are sometimes found only on the more illuminated margin while most of the megazooids accumulate on the other side. I have found that, when taken from the light of a north window and placed in bright sunlight at a south window, megazooids will at first be neutral or even shun the light, but later will recover from the shock and swim toward the more intense light; red zooids recover most quickly and young green ones more quickly than older ones of the same color. The microzooids, on the other hand, from the very first swim toward the increased light, and when the slide is turned around they instantly turn and swim to the newly illuminated side. If, while they are moving from one side to the other, the sunlight is cut off they will go to all parts of the drop, but when the sunlight is again admitted they will immediately swim toward it.

Zooids transferred from the light of a north window to bright sunlight will not live for more than an hour, and the microzooids usually not so long as that, though they thrive when cultivated in sunlight from the first or when the change is gradual.

CONDITIONS AFFECTING VITALITY.

The difficulty of obtaining a long cycle of development in drop cultures, owing probably to insufficient aëration, has prevented the determination of the number of generations that may be produced in a cycle. There is every reason to believe, however, as Braun and Cohn supposed, that a considerable number of successive motile generations may be formed in a colony. The colony may remain in the motile state for a few days or even for three or four weeks. The length of this period depends in some measure, at least, upon the food supply. My best results have been obtained in cultures containing decaying vegetable matter; somewhat less

successful has been the use of Sachs' food solution. Good light and aëration also encourage longer movement. It has been thought (Cohn '50) that zooids kept in the dark would not produce secondary generations, and very generally I have found this to be the case; such a condition might easily be accounted for by the fact that the darkness does not allow a growth vigorous enough to promote this asexual division. Zooids kept in darkened cultures generally remain small, and after some days it will be found that they are narrower and more attenuated anteriorly than those kept under normal conditions (Fig. 36). That secondary division is not impossible, however, in cultures to which light has not been admitted, is proved by the fact that I have sometimes found cells producing zooids of the second or third generation after two days in such cultures (Fig. 31). After the zooids have finally come to rest and acquired a thick, permanent cell-wall no further division will take place until after some change in the environment. Alexander Braun ('51) stated that desiccation must intervene; otherwise the cells would become blanched and lifeless. Often my cultures have confirmed this opinion, but during the present winter I have repeatedly found that freezing will meet the requirement just as well; in fact, propagation has been more vigorous after freezing than after drying, possibly because desiccation is sometimes too rapid in a warm room.

Dangeard ('88) says that he kept resting cells in the bottom of a vase for a year without desiccation and then, when they were transferred to damp cells, division occurred. Nevertheless it is not impossible that freezing or a new food supply brought about the required change in this case.

RELATION OF SPHAERELLA NIVALIS TO S. LACUSTRIS

Rabenhorst ('68) expressed a doubt as to the distinctness of these two species. Rostafinski ('75) after studying for four years the development of the species then called *Chlamydococcus pluvialis*, but without having seen *C. nivalis*, united the latter with the former under the name *Haematococcus lacustris* (Girod) Rostaf. The grounds for making this union were (1) The similarity of the development of the two species as shown by the comparison of some (apparently unpublished) drawings of *C. nivalis* by Schimper

with what Rostafinski knew in regard to *C. pluvialis*; (2) The fact (?)* that he was able to cultivate *Chlamydococcus pluvialis* in snow and to produce zoöspores at a low temperature.

Now in making this physiological point, which remains unconfirmed, a ground of identity, more important points of difference of a similar nature have been left out of account. There is no record to show that *Sphaerella nivalis* may be cultivated at an ordinary temperature; on the contrary, Chodat ('96) was unable to cultivate a red snow alga (which he supposed to be *S. nivalis*) except at a very low temperature. Furthermore, Cohn ('54) was unable to produce any development from "red snow" material either when preserved in snow water or dried, while Braun ('51) records that motile cells were obtained from material of *Sphaerella lucustris* after it had been preserved seven years in a herbarium.

I have myself attempted without success to cultivate in snow some of the "red snow" cells which have preserved their color and normal appearance in spite of being kept in the melted snow for over two years.

The only important morphological difference seems to be that no protoplasmic threads connecting the central mass with the cell-wall have been observed in *Sphaerella nivalis*. This, together with the physiological difference mentioned above, has seemed to Chodat ('96) sufficient ground for maintaining even the generic distinctness of the two species, and he, therefore, retains the name *Haematococcus lacustris* to separate this species from *Sphaerella nivalis*. It appears to me, however, that no more than a specific distinctness between the two forms can be maintained.

NOMENCLATURE

The nomenclature of *Sphaerella* is in such a confused state that it has given rise to some serious errors in regard to the life history. A brief historical sketch may therefore be found desirable.

In 1828 Agardh† established the genus *Haematococcus* and transferred to it the species he had previously called *Protococcus nivalis*.‡. When Flotow published his memoir in 1844, not being

* See section on vegetative division.

† C. A. Agardh. Icon. Alg. Eur. Nos. 21–23, 1828.

‡ Syst. Alg. 13. 1824.

able to identify his plant with any described earlier, he called it *Haematococcus pluvialis.*

Kützing ('45) rejected the genus *Haematococcus* and placed the species of Flotow under Agardh's first genus *Protococcus*, and this name was adopted by Cohn ('53).

Alexander Braun ('51), considering our species generically distinct from *Haematococcus* (*Protococcus*) *nivalis*, founded for it a new genus and gave it the name *Chlamydococcus pluvialis.*

In 1875 Rostafinski decided that this species was generically and even specifically identical with the "red snow" species and therefore restored it to the genus *Haematococcus;* he further identified it with the *Volvox lacustris* described by Girod-Chantrans in 1802, and made the new combination *Haematococcus lacustris.* Perty ('52) had anticipated Rostafinski in recognizing Girod's *Volvox lacustris* as the commonly known species, but he regarded it as an animal when in the motile condition and gave it the name *Hysginum pluviale*, placing it in his class Phytozooidia.

In 1883 Wittrock* revived for the "red snow" species the name *Sphaerella nivalis* Sommerf. which, though four years older than *Haematococcus nivalis* Ag., had never come into general use. In 1886 Wittrock changed our rainwater species which he had previously called *Haematococcus lacustris*† to *Sphaerella pluvialis.*‡

It is not clear why he did not keep the specific name *lacustris*: it may be that he was influenced by the fact that Cohn ('81, '82) had refused to accept it, mainly on the ground that Girod's *Volvox lacustris* was found in salt water while the common species is now known only in fresh water. Finally, however, Wittrock§ returned to the first specific name with the combination *Sphaerella lacustris* (Girod) Wittr.

Objection to the revival of Sommerfelt's generic name *Sphaerella* was made by Berlese and De Toni ('87) on the ground (1) That the genus was poorly defined, and (2) That it would cause

* V. B. Wittrock. Om snöns och isens flora särskildt i artiska trakterna. Stockholm. 1883.

† Wittrock and Nordstedt. Alg. Exsic. No. 156. 1878.

‡ Ibid. No. 733. 1886.

§ A. Hansgirg. Prodromus der Algen Flora von Böhmen. Arch. d. Nat. Land. v. Böhm. 6^6: 105. 1888.

a great increase of synonyms if this revival were to hold, for it would necessitate the change of name of the large number of species of the fungus genus *Sphaerella* established by Cesati and De Notaris in 1863.

As for the first objection, in spite of the fact that the original characterization of Sommerfelt's genus is brief and under it is included a species now known to belong to another genus (*Palmella botryoides* (Lyngb.) Kütz.), nevertheless the well-known species *Sphaerella nivalis* is placed first and the genus was evidently founded on it. The second objection has no weight, certainly at the present time, for most of the species of the genus of Cesati and De Notaris have now been transferred* to *Mycosphaerella*, a genus established in 1885 by Johanson† to take the place of the genus of Cesati and De Notaris.

It is clear, then, that the name *Haematococcus* established by Agardh in 1828 must give way to *Sphaerella* established by Sommerfelt ('24) four years earlier.

In the following list I have omitted *Haematococcus mucosus* Morr., first identified with our species by Rabenhorst ('68) because I cannot recognize in Morren's description or figures any sufficient resemblance to *Sphaerella*. I have added *Disceraea purpurea* Morr. which, though it is identical with our species and was so regarded by Cohn ('50) and Perty ('52), has been omitted from other lists of synonyms, probably because Morren considered his organism an animal.

It may be remarked that among modern zoölogists Stein and Bütschli have included our alga, together with the rest of the Volvocaceae, in the Protozoa, but Saville-Kent and most authors of biological text-books have—with more justice as it appears to us—relegated it to the plant realm.

SYNONOMY

Volvox lacustris Girod. Rech. chim. et mic. 54, 186. 1802.

Protococcus monospermus Corda; Sturm's Deutschland's Flora 2^{25}: 1829–32.

Disceraea purpurea Morren. Rech. phys. sur les Hydroph. d. Belg. 3: 37–43; 4: 42–45. Nouv. Mem. Acad. Roy. Sci. Brux. **14**: 1841.

* See Engler and Prantl. Die nat. Pflanzenfam. 1^{1}: 423–426. 1897.

† Öfvers. af K. Svensk. Vet. Akad. Förhand. 41^{9}: 163, 164. 1885.

Haematococcus Cordae Meneghini. Mem. R. Accad. Sci. di Tor. II. **5**: 20. 1843.

Haematococcus pluvialis Flotow. Nov. Act. Acad. Caes. **20**^{2}: 413–606. 1844. Sachs ('76, '87), Cohn ('81, '82), Bütschli ('84), Parker ('93), Zopf ('95).

Protococcus pluvialis Kützing. Phyc. Germ. 146. 1845. Tab. Phyc. **1**: 2. 1849. Cohn ('50), White ('80), Gibson ('89), Bennett and Murray ('89), Huxley and Martin ('92).

Protosphaeria pluvialis Trevisan. Atti Congr. Sci. Ital. in Ven. 28. 1848.

Protosphaeria Cordae Trevisan. Atti Congr. Sci. Ital. in Ven. 28. 1848.

Chlamydococcus pluvialis Al. Braun. Betracht. über die Erschein. d. Verjüng. in d. Nat. 219. 1851. Cohn ('52, '54, '67), Pritchard ('61), Rabenhorst ('68), Velten ('71), Rostafinski ('71), Stein ('78), Kirchner, Krypt.-Flor. Schles. 1878. Wolle, Fresh-Water Alg. U. S. 164. 1887. Cooke, Brit. Fresh-Water Alg. 51. 1882. Demetzky ('83), De Toni and Levi, Flor. Alg. Ven. 1888. Dangeard ('88).

Hysginum pluviale Perty. Zur Kentn. kleinst. Lebensf. 87–95. 1852.

Haematococcus lacustris (Girod) Rostafinski. Mem. Soc. Nat. Sci. Nat. Cherb. II. **9**: 140. 1875. De Toni ('89), Chodat ('96, '97), Phyc. Bor. Am. No. 114. 1895. Bütschli ('84, *Pl. 43*).

Sphaerella pluvialis (Flot.) Wittrock. Wittr. and Nordst. Alg. Exsic. No. 733. 1886. Wille; Engler and Prantl, Die nat. Pflanz. **1**^{2}: 39. 1897.

Sphaerella lacustris (Girod) Wittrock. Arch. d. Nat. Land. v. Böhm. **6**^{6}: 105. 1888.

SUMMARY

A. Life History

I. THE ORDINARY CYCLE OF DEVELOPMENT

1. The normal resting-cell forms by endogenous division four, eight, or sixteen daughter-cells.

2a. Under unfavorable conditions these daughter-cells remain in the resting condition and return to stage 1.

2b. Under favorable conditions these daughter-cells escape from the mother-cell-wall as free-swimming megazooids, which may while motile grow to four times their original size.

3*a*. These megazooids may return immediately to the resting condition 1, by secreting a new thick cell-wall inside the distended wall which they possess as zooids, or

3*b*. The megazooids may come to rest temporarily, not forming any thick cell-wall.

4*a*. These temporarily resting zooids may divide into two or four new megazooids which repeat the development of 2*b*, indefinitely, or

4*b*. They may form eight, sixteen, thirty-two, or sixty-four (?) microzooids which swarm actively inside the mother-cell-wall and finally break out.

5*a*. These microzooids frequently die.

5*b*. Sometimes they come to rest, form a cell-wall and increase to the size of ordinary resting-cells.

II. THE CYCLE OF MICROZOOIDS

Certain resting-cells (probably poorly nourished) form instead of megazooids, eight, sixteen, thirty-two, or sixty-four (?) microzooids which die or conjugate (?) or grow into the ordinary resting-cells.

B. General Conclusions

1. There are two forms of motile cells produced by *Sphaerella lacustris:* megazooids and microzooids.

2. The megazooids are asexual.

3. No conjugation of microzooids has been observed, but from the conditions of their formation we should expect to find such a process.

4. The vegetative division does not differ in manner from the formation of megazooids; unfavorable conditions prevent the assumption of the motile state.

5. *Sphaerella lacustris* does not pass into an amoeboid form.

6. The cell-wall both in motile and resting conditions consists of cellulose.

7. Several pyrenoids about which starch is deposited are embedded in the chromatophore.

8. No contractile vacuole is present.

9. Haematochrom is a substance closely allied to chlorophyl

but more stable; its value probably lies in this stability and perhaps also in its protective and heat-producing power.

10. The zooids are generally strongly attracted toward the light.

11. Some interruption of development such as desiccation or freezing is necessary for preservation of vitality.

12. *Sphaerella lacustris* is to be regarded as a plant because of the possession of a cellulose cell-wall and chlorophyl and the holophytic mode of nutrition.

13. The "red snow" species *Sphaerella nivalis* is regarded as distinct from *S. lacustris* on the grounds of morphological and physiological differences.

LITERATURE

In the following list the important papers relating to the life history and nomenclature of *Sphaerella lacustris* are collected. It has been intended also to note all original illustrations.

The memoir of Braun ('51) gives by far the clearest and most accurate account of the life history, but it has been little used by later writers. The work of Cohn ('50) which has been chiefly drawn upon for brief accounts, though of great value, is nevertheless not so clear, and has been misrepresented in translations and abstracts. There are several minor accounts in text-books, which, possessing no merit of originality and in some cases the positive demerit of inaccuracy, have not been included in this list.

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COLUMBIA UNIVERSITY, April, 1899.

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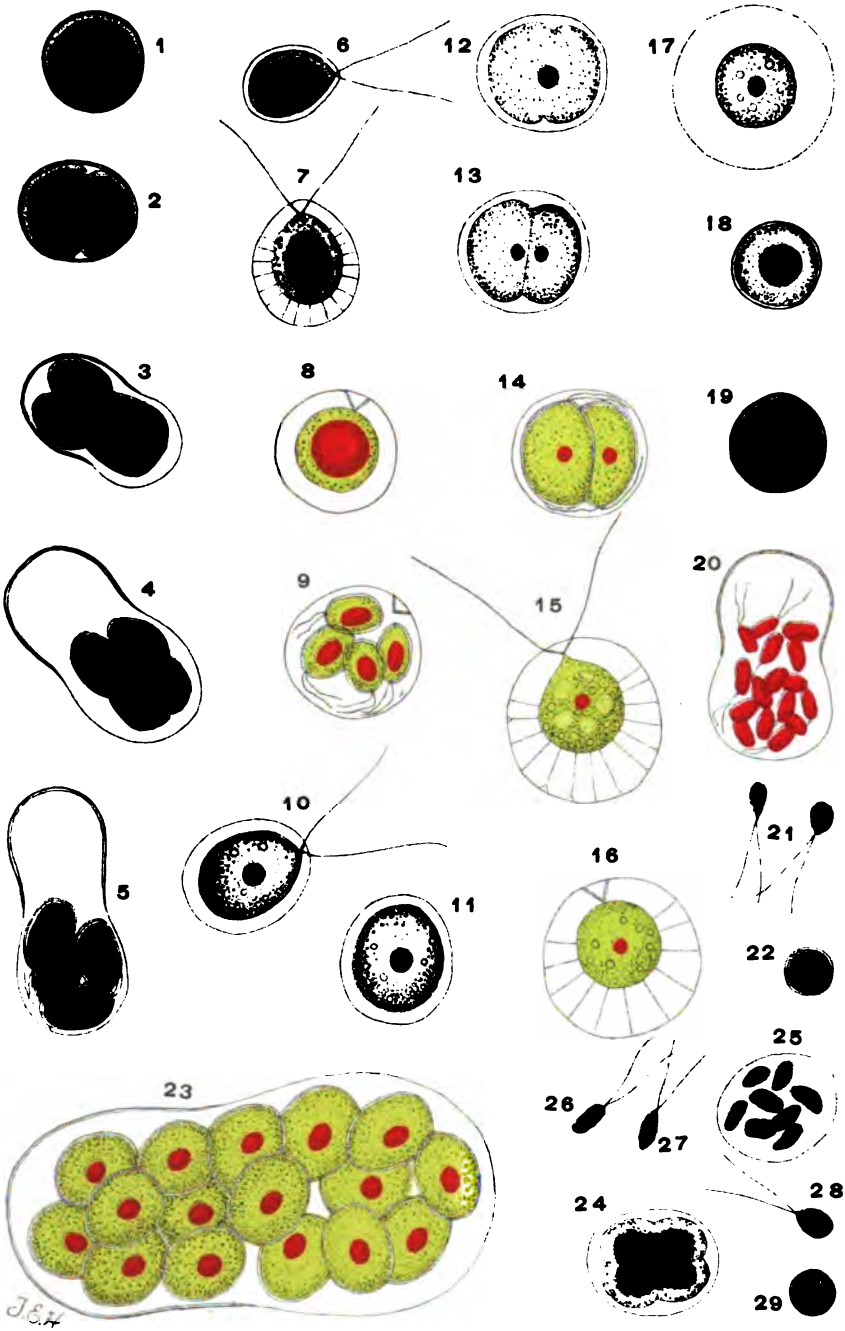

SPHAERELLA LACUSTRIS (Girod.) Wittrock.

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Explanation of Plate 86

Figures 1–19 have been placed in a series so as to illustrate the ordinary cycle of development. Figures 19–22 represent the cycle of the microzooids as far as it has been observed.

Fig. 1. A typical resting cell.

Fig. 2. The beginning of division. 8:00 a. m.

Fig. 3. The transverse division completed, longitudinal division completed in one hemisphere; the outer layer of the cell-wall has ruptured and the thin inner layer is pushed out. 8:30 a. m.

Fig. 4. Division nearly completed. 9:00 a. m.

Fig. 5. The daughter-cells are clothed with delicate cell-walls and their cilia are seen just before they break out. 9:15 a. m.

Fig. 6. One of the megazooids after swimming freely for an hour or two, has acquired a narrow yellowish-green border of chlorophyl.

Fig. 7. A megazooid several hours older, showing the radial protoplasmic threads and widely distended cell-wall.

Fig. 8. A quiescent megazooid whose protoplasmic processes have disappeared in preparation for division; the sheaths which invested the bases of the cilia remain.

Fig. 9. Four megazooids produced on the second morning. 9:15 a. m.

Fig. 10. A megazooid of the second generation which has developed considerable chlorophyl and prominent pyrenoids.

Fig. 11. The same become quiescent for division.

Fig. 12. Beginning of division to form the third (or a later ?) generation. 8:30 a. m.

Fig. 13. Continuation of division. 8:45.

Fig. 14. The daughter-cells completely formed turn inside the mother cell-wall. 11:30. No further growth was perceptible before 2:15 p. m. when the megazooids escaped.

Fig. 15. A mature megazooid showing a vacuolated chromatophore, and finely branched protoplasmic threads.

Fig. 16. The same become quiescent.

Fig. 17. The thick, permanent cell-wall formed; the distended wall of the zooid disintegrating.

Fig. 18. Increase of haematochrom as resting condition advances.

Fig. 19. The resting-cell; the cycle of development closed.

Fig. 20. After desiccation or freezing the resting-cell of Fig. 19 forms sixteen microzooids.

Fig. 21. Microzooids.

Fig. 22. A microzooid come to the resting condition.

Fig. 23. A cell taken from resting vegetation (frozen) producing sixteen large megazooids in the laboratory. [Dec. 2, New York.]

Fig. 24. A first-generation megazooid beginning to divide. 9:30 a. m.

Fig. 25. Continuation: eight microzooids swarming. 10:30.

Figs. 26, 27, 28. Different forms of microzooids.

Fig. 29. One of these microzooids going into the resting state.

Explanation of Plate 87

Fig. 30. Optical section of a mature megazooid of average size. [Baltimore.]

Fig. 31. Two zooids produced in a megazooid kept in the dark two days. [Burlington.]

Fig. 32. Megazooids devoid of haematochrom, from a colony two weeks old. [Baltimore.]

Fig. 33. Production of a secondary generation where the haematochrom has all gone into one daughter-cell, uncommon. [Burlington.]

Fig. 34. So small a slit is made that the zooid is compressed in squeezing out, but

Fig. 35. It soon resumes the usual form.

Fig. 36. A zooid developed in darkness three days. [Burlington.].

Fig. 37. A late generation in which the lifeless cilia of the mother-cell remain during division. [Baltimore.]

Fig. 38. The mother-cilia, still active, are attached to one of the daughter-zooids, both of which move independently. [Baltimore.]

Fig. 39. A megazooid ciliated at each end. [New York.]

Fig. 40. A pair of megazooids incompletely separated. [Burlington.]

Fig. 41. A similar monstrosity with three heads [Burlington.]

Figs. 42–44. Fusion of a pair of incompletely formed megazooids. [Burlington.]

Fig. 45. A cell from resting vegetation in open air. [Feb. 1, New York.]

Fig. 46. The same cell commencing division the next morning. 9 : 00 a. m.

Fig. 47. Continuation of division. 9 : 10.

Fig. 48. Later stage. 9:30. No further growth except that the formation of cell-walls was visible when the magazooids escaped at 10 : 30.

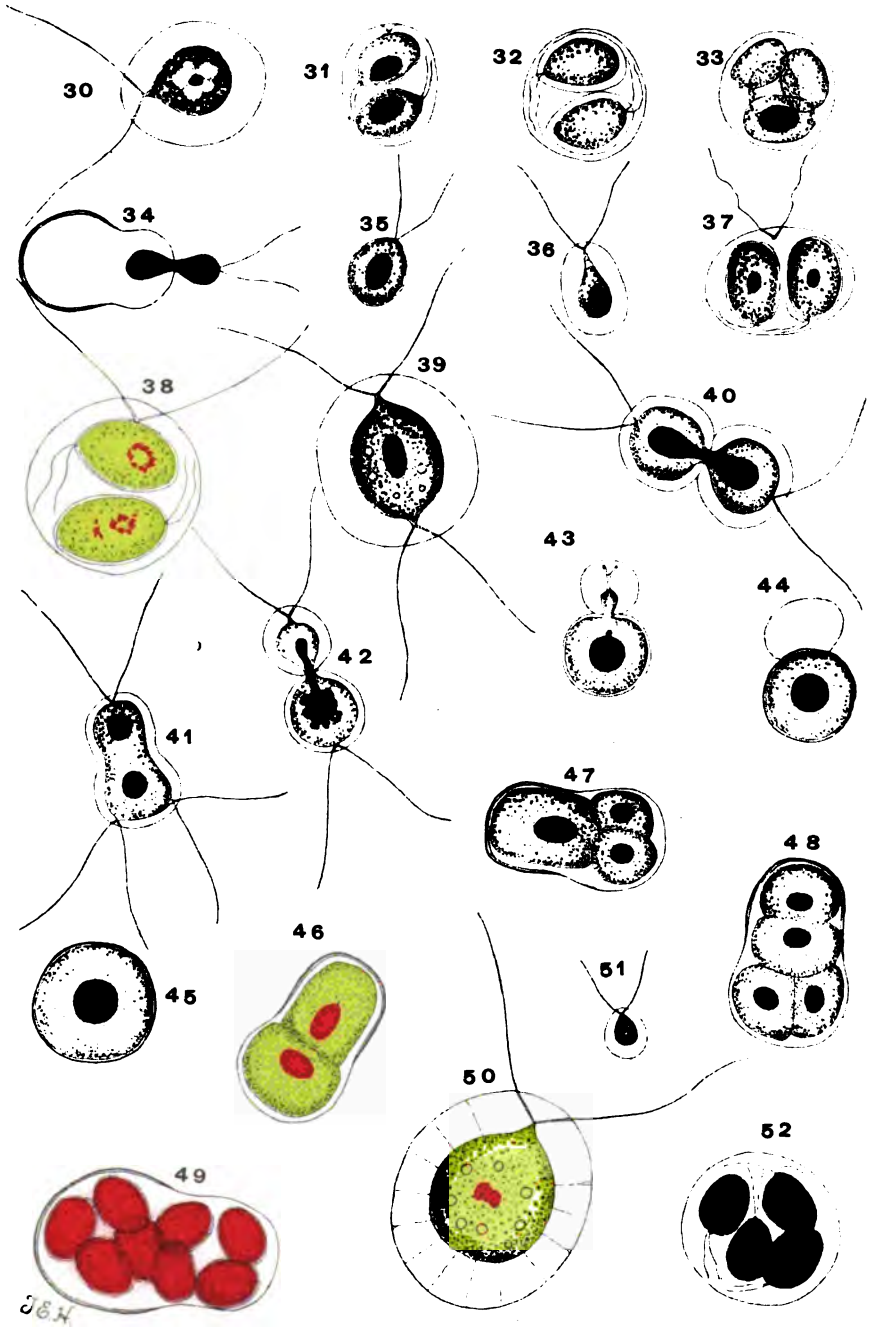
Fig. 49. Eight daughter-cells of the first generation; prevented from becoming motile apparently by cold. [Burlington.]

Fig. 50. An extremely large megazooid (48 μ long) with a solid chromatophore. [New York.]

Fig. 51. A very small mature megazooid, 10 μ long. [Ithaca.]

Fig. 52. Four megazooids of the second generation from a zooid which had remained red twenty-four hours. [Burlington.]

Note. All the figures are magnified about 630 times; in all cases the living plants were carefully measured by means of an eyepiece micrometer and drawn to scale as though projected by a camera lucida. The colors represent the average, but do not indicate the great variety of tints shown in the living plants under different conditions. In most cases the source of the material from which each figure was drawn is appended to its description.



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MEMOIRS

OF THE

TORREY BOTANICAL CLUB

Vol. VI No. 4

A Review of the Genera of Ferns proposed prior to 1832

By Lucien Marcus Underwood

The problem involved in the natural limitations of fern genera has given rise to as much difference of opinion as any question connected with the systematic study of plants, as the amount of literature bearing on the subject fully attests. With slight modifications and differences, the later Hookerian * system of a few genera founded mostly on purely artificial characters has hitherto been followed in America and has no doubt been productive of advantage in the study of so limited a flora as our own, because of its simplicity; but the time has passed for this sort of contraction and we must look at fern genera from the broader standpoint of other English and continental writers and attempt to replace the unjust, unnatural, and unscientific system that has become stereotyped worldwide by its advantage of utility, by other and better systems that have been proposed.

We have characterized this system as the *later* Hookerian system since it is strikingly in contrast with the one faithfully portrayed in the elder Hooker's *Genera Filicum*, whose merit was really due, as stated in the preface to that work, to its high artistic character, reflecting through the power of Bauer's splendid delineations the system already proposed by Presl in a masterly yet far more simple manner.

* As expressed by Sir W. J. Hooker in *Species Filicum*, and Hooker and Baker in *Synopsis Filicum*. The leading differences heretofore maintained by American botanists have been: (1) The separation of *Phegopteris* from *Polypodium*, (2) The separation of *Camptosorus* from *Scolopendrium* and (3) The unfortunate union of *Aspidium* and *Nephrodium*.

We have spoken of the later Hookerian system as unjust because it ignores in too many cases the claims of prior publications; as unnatural because it associates together in the same genera forms of growth, that have no natural association or alliance whatever, but are thrown together because they possess the accidental peculiarity of some such secondary or trivial character as "no involucre" or "sori following the veins and like them free, forked or anastomosing," thus making of genera unholy alliances of unrelated entities instead of natural groups of closely associated species. One has only to compare the heterogeneous assemblages of plants arrayed in *Synopsis Filicum* under such generic names as *Gymnogramme*, *Acrostichum*, *Polypodium*, *Dicksonia*, and *Davallia*, to appreciate the unnatural character of these generic concepts. The members of a natural genus should resemble one another sufficiently to enable one to attribute to them a monophyletic origin. We have spoken of the system as unscientific for the same reason, added to the fact that it has largely ignored anything except the superficial leaf form and soral arrangement of the sporophyte in the separation of genera and the determination of affinities, leaving in the background the biological characters of the stem, habit alliances, and the subject of venation, so important in the study of affinities in any modern sense. In short, the whole later Hookerian system of genera is the natural result of a too exclusive study of herbarium sheets and a convenient method of rapidly "pigeon-holing" a lot of plants that must be named for correspondents, rather than a logical scientific study of the living fern world and the interrelations of its diversified forms.

If we are to have genera simply as a matter of convenience for naming plants, then this system is, perhaps, as good as any that has been proposed; but if we are to look upon genera as natural groups of allied species, then we must seek for a more exact representation of the fern world, holding ever in view the fact that in many cases where the links of the evolution are still in existence certain genera like some species will necessarily intergrade. It must further be borne in mind that no system founded with Linnaean concepts of species can fit an organic world of progressing organisms formed on a Darwinian or Lamarckian plan.

No one can question two facts stated by Hooker, namely, that

his own herbarium collection (since his day greatly augmented by the vast accumulation of recent and much more perfect examples from all parts of the world) is the richest in existence,* and that the collection of growing ferns at Kew Gardens is one of the largest collections in the world, but with the last circumstance in mind, it seems incredible that this collection of living plants has played so insignificant a part in the system of generic classification of any of the Kew workers, with the single exception of John Smith, so long head gardener at Kew, whose review of fern genera† presents a system infinitely more natural, logical, and scientific than that of the system under discussion. The merits of Smith's system were indeed recognized by Hooker, but unfortunately not followed in the slightest particular in Hooker's later publications nor in those which have followed him, as these have faithfully carried out the plans which Hooker so clearly laid down. And thus it is that we in America have too long continued to speak of the delicate *Nephrodium punctilobulum* of Michaux as a *Dicksonia*—a genus based on tree ferns of the Southern Hemisphere and belonging to an entirely different family from our own species, because, forsooth, all the plants of these genera agree in having "inferior cup-shaped or bivalved indusia," and in our newly acquired Sandwich Island territory we are asked to regard the noble species of *Cibotium* in the same category! In short the *Synopsis Filicum* of 1874 with its supplements extending to the present time, while describing often in too comprehensive a manner (and with little regard for geographic distribution as a factor in specific distinctions) five times the number of species of ferns of the first *Synopsis Filicum* of 1806,‡ in its representation of genera is little in advance of its original namesake. And while Hooker's *Species Filicum* will always stand as a classic in the characterization of species, in its

* The fern collection at Kew is contained in thirty-six cases, each with sixteen compartments 13.5 cm. deep. *Pteris* fills nearly two cases, *Asplenium* four cases, *Aspidium* and *Nephrodium* together six cases, *Phegopteris* and *Polypodium* together five cases, and *Acrostichum* about two cases. These data will enable those who have never visited Kew to form some idea of the vastness of the collection.

† *Historia Filicum*, 1875; and earlier papers commencing with his first discussion of Fern genera, Hooker's Journ. Bot. 4: 38–70; 147–198. 1841; London Journ. Bot. 1: 419–438; 659–668. 1842.

‡ Swartz, *Synopsis Filicum*, 1806.

treatment of genera, it is systematically as unsatisfactory as is *Synopsis Filicum* in its treatment of species.

With the purpose then of arriving at the foundations of the problem of fern genera, and actuated by the spirit of Lincoln's aphorism, "If we could first know where we are and whither we are tending, we could better judge what to do, and how to do it," we shall seek for a rational basis for the system by reviewing historically the fern genera that successive authors have proposed, with a view of recognizing in accord with principles of justice the earlier established genera and the foundations on which they rest. To do this more satisfactorily we have thought it wise to separate the problem into two periods and treat the earlier and more fundamental somewhat independently. We have selected the year 1832 as a convenient line of separation, as that will place in the second period all the wholesale establishments of genera by the later writers, especially Presl, Fée, Moore, and John Smith. The period commences with 1753 and closes with the completion of Hooker and Greville's *Icones Filicum*, 1831.

In this study of generic foundations there is necessarily little that is novel except that the principles which we shall follow in this recognition of genera involve certain elements in which there is neither uniformity of practice among taxonomists nor authoritative ruling. It is, therefore, best to state the basis on which the recognition of the rights of genera will here proceed. We will give sufficient data, however, selected after an extended bibliographic research which includes all the original publications of fern genera* so that others working from other principles may be enabled from these data to base their own conclusions.

The principles here followed are:

1. Only genera established in Linnaeus' *Species Plantarum*; 1753, or later are considered. (Rochester Rules.)

2. No genus is considered as established unless it is: (*a*) Based on one or more previously described species which are referred to

* In addition to home facilities, the libraries of Kew Herbarium and the Berliner Hof-Museum, together with the splendid collection of serials at the British Museum (Cromwell Road) have furnished most of the rarer references, but a few were not to be found even in these extensive collections. For one of Kaulfuss' rarer papers we were indebted to the unique library of the Surgeon-General's Office at Washington, and Professor E. L. Greene's library furnished the only available copy of *Deliciae Pragenses*.

with sufficient directness as to be recognizable, or (*b*) Based on some species which is described for the first time at the establishment of the genus itself. Generic names founded with no hint of a species on which they can rest as a type will not be considered as holding any priority rights against genera capable of being anchored to definite type species.*

3. For each genus established the first named species will be regarded as the type, and to insure stability of nomenclature, and to prevent the shifting of generic names to groups of species wholly unlike those for which the original author founded the name,† it will be regarded as essential that the type species and the generic name shall be inseparable and shall be maintained or reduced to synonymy according to the necessities of the case.

In the application of this rule the following exceptional cases must be noted: (*a*) In the genera of Linnaeus' *Species Plantarum* of 1753, the fact must be borne in mind that while the genera date from 1753, they did not all originate with *Species Plantarum* or even with Linnaeus. These Linnaean genera must then be traced to their type species wherever they originated. In case the original generic name was used in another sense than that in which it was adopted by Linnaeus,‡ the type of the genus *in the Linnaean sense* must be determined wherever it was first used; and (*b*) In genera established with a definite statement of the type on which the author founded the genus, this type must have preference even tho in a subsequent list of species it is not the first enumerated.§

* Previous discussion of the subject of generic stability has appeared hitherto by O. F. Cook in Bull. Torrey Bot. Club, 22: 431–434. 31 O. 1895, and in Science, II. 8: 186–190, 12 Au. 1898; 513–516. 14 O. 1898. Dr. B. L. Robinson has also partially stated the problem in Bot. Gaz. 25: 437–445. Je. 1898.

† That this has often happened in the past can be shown in many cases, *e. g.*, *Nephrodium*. This genus, the § *Eunephrodium* of Synopsis Filicum, has been limited to species of *Aspidieae* with reniform indusia and veinlets of contiguous groups united, whereas the genus *Nephrodium* as established by Richard in Michaux's Flora Bor. Am. was based entirely on free veined species of *Polystichum* and *Dryopteris* and does not contain a single species of the group to which it has been thus limited!

‡ As, *e. g.*, *Trichomanes*, whose type was *Asplenium Trichomanes* as known to Linnaeus. *Hemionitis* and *Lonchites* are other examples; see below under 1753.

§ While no general ruling has ever been made on this question, many botanists profess to use the so-called "method of residues"; but even here, no systematic attempt has ever been made to carry out this principle, and many known exceptions occur in prac-

4. While homonyms that may in the future interfere with stability are not to be admitted as valid genera, the extreme and inflexible application of the law to those cases where interference is clearly impossible is neither necessary nor desirable. Such cases as that of *Angiopteris* Hoffm. will not be displaced because of a homonym of this nature.

5. In general, the laws of evidence and interpretation usually recognized will be followed with the view of ascertaining an author's intended meaning. Mere technicalities based on legal quibbles have no place in a rational system of nomenclature. Here, as elsewhere, it is "the letter that kills but the spirit that maketh alive."

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With these principles in view we proceed to a brief historical

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tice. The method of "residues" works on the principle that the last species remaining in the genus from those originally named by its author when the genus was founded shall constitute the type of the genus and shall hold the generic name. This method, moreover, has the disadvantage of being variously interpreted by different people. While it may be true that early writers did not always name the most typical species first, it is equally true that the last species to remain in the genus after division has taken place is less likely to be a typical form; in fact, if doubtful or little known species are placed in a genus originally, these are the very ones which are unlikely to be taken away from the original group to form other genera. The system of "residues," moreover, has a shifting instead of a fixed type, varying as more and more of the original species are taken out to form other genera, thus leaving a smaller and smaller residue.

A few of the many reasons for accepting the principle of the first species under a genus, instead of that of "residues" are the following:

1. It is more direct, simple, and natural in its application.

2. It is strictly in accord with a system which recognizes priority of publication as a fundamental principle. It conforms with the practice generally in use for recognizing the type of a species originally described from composite material.

3. It is in accord with a starting point for genera (1753) which in the absence of generic descriptions can only base its original genera on species instead of generic descriptions.

4 It is of universal application, while the principle of residues, besides being capable of various interpretations, cannot be applied to the many cases in which several genera each containing numerous species were organized independently at nearly the same time. As a test of this, let the believer in residues attempt to adjust generic limitations on the groups involved in *Polystichum* Roth (1800), *Aspidium* Swz. (1801), *Tectaria* Cav. (1801), and *Nephrodium* Rich. (1803)—generic groups based on similar but varying aggregates of species.

5. It is the least unjust to the author of genera based originally on several species.

6. It anchors a generic name to a species with which it must rise or fall, according as that type species is or is not a part of a distinct generic group, and prevents it from being shifted along to a smaller and smaller group, or even of being shifted to a group of species of which its original describer knew nothing.

review of the 189 fern genera proposed by the forty-three authors who wrote on ferns during the period 1753–1831 arranged in chronological order, and suppemented by an alphabetical tabular summary of the resulting necessary synonymy:

1753

Linnaeus (*Species Plantarum*) recognized the following genera of ferns:

1. ONOCLEA (1062) with a single species, *O. sensibilis*. The generic name was established in Amoen. Acad. **3**: 20. 1751, and Linnaeus needlessly displaced an earlier name, *Angiopteris* Mitch., which he quotes as a synonym. The practice thus early inaugurated by Linnaeus of arbitrarily replacing well-established names for others was commonly followed by his successors, and even yet is practiced in some quarters, and has been the cause of much of the present unsettled condition.

2. OPHIOGLOSSUM (1062) with *O. vulgatum* and five other species of which two are now species of *Lygodium*. The genus was founded by Tournefort (Inst. 548. *pl. 325.* 1700), on the European *O. vulgatum*, and was thence accepted by Linnaeus (Gen. Pl. 322. 1737) and in Hort. Cliff. 472, where three species were noted. According to Sprengel this name was first used by Tragus, 1551.

3. OSMUNDA (1063) was a curious composite based on seventeen species* now distributed among many diverse genera. The genus dates back to Tournefort (Inst. 547. *pl. 324.* 1700) and is based on the European *O. regalis;* it was first adopted by Linnaeus (Gen. Pl. 322. 1737) who cites Tournefort, and in Hort. Cliff. 472, five species are noted. According to Sprengel, the name was first employed by Lobel in 1571.

4. ACROSTICHUM (1067) included twenty-five species which are known to-day under the genera *Asplenium*, *Woodwardia*, *Nothoiaena*, *Woodsia*, *Gymnogramma*, *Schizaea*, *Todea* and others.

The original *Acrostichum* appears to be that of Linnaeus (Gen. Pl. 322. 1737) who cites numerous figures of Plumier, and Tour-

* We have already discussed the generic limitation *Cf.* Bull. Torrey Bot. Club, **25**: 522–525. 1898. The recent attempt to abandon the generic name, *Osmunda*, is contrary to both the spirit and the letter of nomenclature. *Cf.* Proc. Biol. Soc. Washington, **13**: 63. 1899.

nefort's genus *Ruta Muraria*. In Hort. Cliff. 475, five species are cited of which the first is the one we know as *A.* (*Chrysodium*) *aureum* which may justly stand as the type of the genus, a conclusion reached by Moore* and others who properly divide the composite as recognized by Hooker into its numerous well-marked genera.

A. lanceolatum, the first species mentioned by Linnaeus in *Species Plantarum*, is a *Polypodium* (§ *Niphobolus*).

5. PTERIS (1073) was adopted with nineteen species all but three of which were American. Linnaeus appears to have first used the generic name as such (Gen. Pl. 322. 1737) citing Plumier's plates 5, 14, 15, 29, 37, 51, 68, 69, 105, 132, 140, 141, 152, and in Hort. Cliff. 473, six species were cited from Plumier's plates 152, 75, 106, 69, 29, and one European species. As Plumier's plate 5 represents *Pteris arborea* L. the fifth species in *Species Plantarum* we may safely regard that as the type of the genus.

6. BLECHNUM (1077) was the only genus founded in *Species Plantarum* and was based on two species, *B. orientale* (Amer. Merid.) and *B. occidentale* (China)† and forms a well-defined genus. *B. orientale*, the American species, will form the generic type, and both species are fortunately congeneric.

7. HEMIONITIS (1077) was adopted for two species, *H. lanceolata* and *H. palmata*, both from tropical America. The original *Hemionitis* of Bauhin and Tournefort‡ was the plant from southern Europe now known as *Asplenium Hemionitis* to which alliance it was correctly relegated by Linnaeus himself. The Linnaean genus was established in Cor. Gen. Pl. 20. 1737, based on Plumier's *pl. 151* and in Hort. Cliff. 477, he cites the same species. As these references are to *H. palmata* that plant must be regarded as the type of the Linnaean genus.

8. LONCHITIS (1078) was based on three tropical American species, *L. hirsuta*, *L. aurita*, and *L. repens*. The original *Lonchitis*§ of Tournefort‖ is *Polypodium Lonchitis* L., which afterwards became

* *Index Filicum*, xxi. 1857.

† Later writers have curiously interchanged these original names perhaps not wisely.

‡ Inst. 546. *pl. 322, 323*. 1700.

§ The *Lonchitis aspera* of Bauhin's Pinax, 359.

‖ Inst. 538. *pl. 314*. 1700.

the type of the genus *Polystichum* Roth. Linnaeus adopted the name *Lonchitis* (Gen. Pl. 322. 1737) for Plumier's plants represented in *pl. 17, 20*, the former being *L. aurita* and the latter *L. hirsuta*. It is thus rational to regard *L. aurita* as the type of the Linnaean genus.*

9. ASPLENIUM (1078) appears to have originated generically with Tournefort (Inst. 544) where *Ceterach*, a somewhat common European fern, is its only foundation. Linnaeus first used the name in *Genera Plantarum*, 322, in which he cites numerous plates from Plumier (13, 19, 41, 46, 59–61, 67, 74, 103, 106, 124, 133†) and adds *Lingua cervina* (= *Phyllitis Scolopendrium*) and *Trichomanes* (= *Asplenium Trichomanes*) of Tournefort. In Hort. Cliff. published the same year, he included five species of which *Lingua cervina, Trichomanes, Marina*, and *Ceterach* are European and Plumier's plate 59 forms the fifth. The name *Asplenium* was used by Matthiolus, 1560, and even by Dioscorides.

In *Species Plantarum* twenty species are enumerated and as is usual the list commences with those with simple leaves, *rhizophylla* (= *Camptosorus*) being first named; curiously enough this involves three species which range in distribution from Jamaica to Siberia! The genus, however, is a more natural group than many of the Linnaean genera, altho several genera have been properly separated from among these twenty species.

We must historically then limit the type of *Asplenium* to the *Ceterach officinarum* of Bauhin's Pinax and of the other pre-Linnaean herbalists. As this is surely a clearly defined generic group distinct from *Asplenium* although united to it with many other strange bedfellows in *Synopsis Filicum*, the acceptance of the principles of historic interpretation and generic types here followed will necessitate the relegation of the numerous species of *Asplenium* to another generic alliance. While changes in nomenclature are

* This genus well illustrates the ridiculous and confusing practice of the botanists of the past generation with reference to generic limits. The genus "*Lonchitis* Linn." of Hooker and Baker's Synopsis Filicum contains the two species *L. pubescens* Willd. and *L. occidentalis* Baker with no reference to the original species except a doubtful comment on *L. aurita* in a note.

† While the greater part of these belong to *Asplenium* as used by modern writers, plate 13 represents a sterile plant of *Pteris pungens* Willd. and plate 19 represents a species of *Diplazium*.

always unfortunate, they are our inheritance from the lack of system of the past generations of botanists, and can never be rationally used in an argument where principles of nomenclature only are involved.* In this case many of the species have already been placed under the genus *Athyrium* which appears to be the next in line.

10. POLYPODIUM (1082) as a genus took its origin from Tournefort (Inst. 540. *pl. 316*), tho the name had been used by Theophrastus, and is based on *P. vulgare*, the common European species. Linnaeus (Gen. Pl. 1737) included *Lonchitis* Tourn. (*Polystichum Lonchitis* Roth) in the genus. In Hort. Cliff. 474 *P. vulgare* is the fourth species mentioned. In *Species Plantarum* 58 species (of which over 60 per cent. are American) are included, of which *P. lanceolatum* (§ *Phymatodes*) is the first named and the genus includes species of *Phegopteris*, *Polystichum*, *Dryopteris*, *Filix*, *Cyathea* and other modern genera.

11. ADIANTUM (1094) also takes its origin from Tournefort (Inst. 543, *pl. 317*), tho the name had been used by Dioscorides, and is naturally based on the common European species *A. capillus-Veneris*. Linnaeus (Gen. Pl. 322. 1737), quotes Tournefort, and in Hort. Cliff. 473 includes four West Indian and Bermuda species. In Species Plantarum 15 species are included, two-thirds of which are American; as in all his fern genera the simple species are first described, *A. reniforme* of Madeira is naturally the first named.

12. TRICHOMANES (1097) was established by Linnaeus (Cor. Gen. Pl. 20. 1737, and Hort. Cliff. 476), as a monotypic genus based on Plumier's plate 86 which is *Trichomanes crispum*. The original *Trichomanes* of Tourn. (Inst. 539. *pl. 315*. 1700) was *Asplenium Trichomanes* as recognized by Linnaeus when he established the latter genus. In *Species Plantarum*, Linnaeus gives eleven species of *Trichomanes*, of which six are American, but includes besides filmy ferns of the genus *Hymenophyllum*, certain thin leaved species of *Davallia*; the first species mentioned is *T. membranacum*, also a true *Trichomanes*, but *T. crispum* is clearly the legitimate type of the Linnaean genus.

* Unfortunately one of the first questions that arises in many minds in considering any question of nomenclature is not "Is the principle a correct or rational one" but "How much change will it involve." So long as this mental condition is rampant a stable rational system is practically impossible.

1756

Hill, in his British Herbal, recognized a series of genera, one of which Professor Greene has recently accepted, and he restored the name *Lunaria*, based on what is now *Botrychium lunaria*, but which was unfortunately adopted by Linnaeus for a genus of flowering plants, and used *Phyllitis* for *Asplenium Scolopendrium;* while most of Hill's plants are figured and clearly recognizable, it still remains a patent fact that his generic groups are arranged to correspond to the usage of the apothecary shops and not named in the Linnaean sense, and certainly such generic (?) names as *Lonchitis-aspera*, *Capillus-Veneris* and *Adiantum-nigrum* cannot be accepted as properly published genera.

1757

Ludwig (Inst. Hist. Phys. Reg. Veg. 142), in his synoptic tables adopted the genus *Phyllitis* based on Tournefort's "*Lingua Cervina*," which appears to be the earliest botanical use of this name as applied to our "Hart's tongue" fern. No other novelties appeared in this little-known work; many later writers of the last century adopted the same generic name which must replace the later *Scolopendrium*.

1760

Scopoli (in the original edition of Flora Carniolica 168), established the genus *Struthiopteris* based on *Osmunda spicant* L., which many years later was placed in *Lomaria*, tho many still refer it to *Blechnum*. The genus was well described, giving full synonymy, and was accepted by many subsequent writers like Haller, Wiggers, Weiss and others, until Willdenow usurped the name for a different plant and established *Lomaria* in its place. There is every reason why a restoration should be made. The specific combination apparently first appeared in Scopoli's second edition.

1764

Gleditsch (Syst. Pl.) established the genera *Cincinalis* (290) and *Pyxidaria* (291), neither of which is based on any species and must therefore be relegated to the domain of nonentities. The former is usually referred to *Pteris*, altho it was characterized as having "Invol. nullum," and the latter is evidently a direct synonym of *Trichomanes*.

1763

Adanson (Famille des Plantes, **2**: 20, 21) recognized twelve genera of ferns of which the following were new: 1. *Thelypteris*, citing "Filix-foemina Fuchs, 596" and "*Pteris* Lin.," among other references, but characterized as having "membrane que borde comme une ligne tout le contour de chaque division des feuilles," and thus being a clear equivalent of *Pteris!*; 2. *Scolopendrium*, clearly based on *Lingua-cervina* Tourn.;* 3. *Ceterac*, based on *Asplenium* of Tournefort which was the common ceterach of Europe; 4. *Filix*, based on *Filix baccifera* Cornut, 5, which is unmistakably our *Cystopteris bulbifera* which Cornut figured in 1635, and which Linnaeus correctly quoted under *Polypodium bulbiferum*; 5. *Dryopteris*, based on *Filix-mas* of Fuchs and Tournefort, *pl. 311, 312*; 6. *Angiopteris*, adopted from Mitch. Gen. 29, and exactly synonymous with *Onoclea* L.

1782

Berg[ius] (Acta Acad. Sci. Imp. Petrop. **6**: 248. *pl. 7, f. 1–3*) established the genus *Caenopteris* based on *Caenopteris furcata* from Bourbon, *C. rutaefolia* from Cape Colony and *C. vivipara* (*Acrostichum viviparum* L.) also from Bourbon. These species have usually been relegated to *Asplenium* (§ *Darea*).

1783

Lamarck (Encyclop. method. Botanique) commenced his treatment of the ferns which continued until 1808 when the work was completed by Poiret. They accepted only the twelve original Linnaean genera, but added considerably to the number of ferns, their enumeration reaching 444 species. (*Cf.* footnote under 1806, Swartz.)

1786

Thouin, according to Pfeiffer, established the genus *Celanthera* "Act. Ac. Paris (?)"; this genus Pfeiffer refers to *Marattia* Swz., which if a true citation it antedates by two years. We have been unable to locate the original of this citation.

* Nearly every writer of the present century has wrongly attributed this name to Smith 1793; it is high time that its original source be publicly noted.

1788

L'Heritier (Sertum Anglicum, 30, 31) established the genus *Dicksonia* based on *D. arborescens* from St. Helena and *D. culcita* of Madeira. This in later times has been widely extended to include plants of the greatest diversity of structure and habit and from it certain genera have justly been separated.

1788

Swartz (Nova Genera et Species Pl. 128) established the genus *Marattia* based on *M. alata* of the West Indies. The genus is usually credited to Smith, 1793. The above date prevents the genus from yielding to *Myriotheca* Comm. 1789, which is probably the same altho it was founded with no type species as a voucher.

1789

Jussieu (*Genera Plantarum*) established the genus *Darea* mentioning no type, and quoted *Myriotheca* Comm. also with no type, in addition to the twelve original Linnaean genera. In the second edition (1791) the same genera are repeated, but in a footnote is a question if *Caenopteris* Berg. is not the same as *Myriotheca* Comm. Later writers have usually referred *Darea* and *Caenopteris* to *Asplenium*, possibly without the best of reasons.

1790

Necker (Elementa Botanica, 3 :) added the genera *Achomanes* (313), *Gleichenia* (314), *Psidopodium* (315), *Onopteris* (316), and *Octosis* (318). None of these are based on types and no earlier references are cited. Pfeiffer regards *Psidopodium* as the equivalent of *Aspidium*, and *Onopteris* of *Asplenium*, and Moore holds the same opinion regarding the latter. *Octosis* and *Glechenia*, Pfeiffer regards as doubtful, but Moore places the latter as a synonym of *Aspidium*. *Achomanes* was later taken up by Presl for a subgenus of Hymenophyllaceae but is commonly regarded as a synonym of *Trichomanes*. Since these genera are neither represented by types nor can be recognized with certainty, it is best to regard them for what they are worth—nonentities—in other words to disregard them as mere names with no bearing on the question of priority.

1791

Schreber (Gen. Pl. 757) established the genus *Meniscium* founded on *Polypodium reticulatum* L.

1792

Richard (Ann. Soc. Hist. Nat. Paris, 114) proposed the genus *Lophidium* based on *L. latifolium* from Guiana. This is therefore the earliest name for a member of the genus *Schizaea* as limited by Hooker, and this portion of the genus may well be separated generically.

1793

Sir J. E. Smith (Mem. Acad. Roy. Sci. Turin, 5:) established genera: 1. *Woodwardia* (411) based on four species, *W. angustifolia* (*Acrostichum areolatum* L.), *W. Japonica*, *W. Virginica* and *W. radicans*. 2. *Vittaria* (413) based on *Pteris lineata* L. 3. *Davallia* (414) based on eight species of which *D. Canariensis* (*Trichomanes Canariensis* L.) is first named. 4. *Cyathea* (416) based on six species of which *C. horrida* (*Polypodium horridum* L.) and *C. multiflora* are first named, with *C. arborea* and *C. Capensis*, followed by such species as *C. fragilis* and *C. montana*. To show the liberties taken with generic types, as well as Smith's hazy conception of affinities, the first two named are now to be looked for under *Hemitelia* and the last two under *Filix* (*Cystopteris*), or in other words a delicate polypodiaceous fern united generically with a group of tree ferns of a wholly distinct family alliance. 5. *Hymenophyllum* (418) based on *Trichomanes Tunbridgense* L. and *T. asplenoides* Swz. together with six others. 6. *Schizaea* (419) based on *Acrostichum pectinatum* L., *A. dichotomum* L. and *A. elegans* Vahl. 7. *Gleichenia* (419) based on *Onoclea polypodioides* L. and 8. *Danaea* (420) based on *Asplenium nodosum* L. and *D. alata*. *Lindsaea* Dryander must also be considered as published here (413) with *Adiantum Guianense* Aubl. as a type since Dryander's paper, altho read 1794 did not appear until 1796. Smith is usually credited with the genus *Scolopendrium* but that, as we have seen, was used long before by Adanson. He is frequently credited also with *Marattia* which originated with Swartz five years earlier.

1793

G. F. Hoffman (Comm. Soc. Reg. Sci. Gött. **12**: 29. *pl. 5*) established the genus *Angiopteris* with a single species based on *Polypodium erectum* Forst. Since the existence of *Angiopteris* Adans. 1763 (adopted from Mitchell) makes this a homonym, the strict application of the Rochester code would necessitate the selection of a new name for this long established and well-known genus. Since *Angiopteris* Adans. is based on *Onoclea sensibilis* and that is the sole species of *Onoclea* L. as published, *Angiopteris* Adans. is absolutely a dead name, with no possibility of resurrection, so long as 1753 remains a starting-point. Only a quibble over a technicality more worthy a pettifogger than a botanist would needlessly displace the name well established by Hoffman.

1796

Dryander published a paper: On *Lindsaea*, a new Genus of Ferns (Linn. Trans. **3**:). The preliminary diagnosis of the genus had already been outlined by Smith (see above, 1793), whence the genus must date, but in this paper Dryander gives more detail together with five plates illustrating the species; nine species are included, commencing with the simple leaved *L. sagittata*, *L. Guianensis* forming the seventh. The paper was read November 4, 1794, and the addition containing the ninth species is dated April 23, 1796, evidently added just before printing. The volume bears the date noted above, which constitutes publication according to modern ideas.

1799

Bernhardi (Schrader's Journ. **1**: 297) established the genus *Gymnopteris* based on *Acrostichum rufum* (*Pteris rufa* L. Sp. Pl. 1074. 1753) a name which has been unfortunately replaced by *Gymnogramma*. He further characterized twenty genera besides *Lindsaea* and *Schizaea* which he had not seen. *Pteris*, *Blechnum*, *Woodwardia* and *Darea* were merged with *Asplenium* while *Ceterac* was united with *Vittaria*. As he quotes *Polystichum* Roth, the work in which that genus was published (or at least a part of it) must have appeared at an earlier date than is usually attributed to it, or than appears on its title page.

1800

Roth (Tent. Fl. Germ. 3:) published (1) *Athyrium* (58) based on seven species,* viz., *A. fontanum, A. Halleri, A. molle, A. trifidum, A. ovatum, A. filix-foemina*, and *A. rhaeticum;* and (2) *Polystichum* (69) based on twelve species, viz., *P. Lonchitis, P. Phegopteris, P. montanum, P. Thelypteris, P. aculeatum, P. Dryopteris, P. filix-mas, P. cristatum, P. frigosum, P. multiflorum, P. spinosum*, and *P. Marantae*. Moore cites for these genera the date 1788 which is the date of the first volume instead of the third, and Pfeiffer cites the date as 1797. The date on the title page is as above, but as the genera were quoted by Bernhardi in 1799 a part at least of the third volume probably appeared some time before the title page; the preface is dated 14 Sept. 1798. The exact date of issue is still a desideratum.

1800

Hedwig (Filicum Gen. et Sp. *fasc. 2*) proposed the name *Ptychomanes* in place of Smith's *Hymenophyllum* in order to have the genera of the family close with a uniform termination! *Trichomanes asplenoides* Swz. served as the basis for this establishment.

1801

Swartz in his Genera et Species Filicum (Schrader's Journ. 1800²:) first elaborated his system. He established:

1. *Grammitis* (17) based on *G. linearis, G. marginella, G. lanceolata, G. serrulata, G. graminoides* and *G. myosuroides.*

2. *Aspidium* (29) based on *A. articulatum, A. pistillare, A. trifoliatum, A. Lonchitis*, and some sixty other species among them species now included in *Asplenium* (*A. filix-foemina*), *Filix*, and *Phegopteris.*

3. *Diplazium* (61) based on *D. plantagineum* (*Asplenium plantagineum* L.) and *D. grandifolium.*

4. *Lygodium* (106) based on *L. scandens* (*Ophioglossum scandens* L.) *L. flexuosum, L. pedatum* and *L. Japonicum.*

5. *Botrychium* (110) based on *B. Lunaria, B. rutaceum, B. Virginianum, B. ternatum*) and *B. zeylandicum.*

* Later in the same year Roth (Cat. Bot. 2: 143) gives *Polypodium bulbiferum* L. as the first species of *Athyrium.*

1801

Bernhardi in a paper published in the pages immediately following that of Swartz (Schrader's Journ. 1800[2]:) recognized twenty-nine genera among which the following new ones were proposed: 1. *Sphaeropteris* * (122) based on *Polypodium medullare* Forst. from New Zealand; 2. *Wibelia* (122) based on *Trichomanes multifidum* Forst. (*Hymenophyllum multifidum* Swz.) from the Pacific Isles; 3. *Struthopteris* (126) based on *Osmunda regalis* and the equivalent of the genus *Osmunda* in its modern sense; 4. *Odontopteris* (127) based on *Ophioglossum scandens* L. (*Lygodium* Swz.); 5. *Ripidium* (127) based on *Acrostichum dichotomum* Forst. (*Schizaea dichotoma* Swz.) from the East Indies; 6. *Gisopteris* (129) based on *Hydroglossum palmatum* Willd. (our own *Lygodium palmatum*); besides two genera of lycopods. He quotes *Todea* and *Hydroglossum* from Willd. (see below under 1802) and it becomes a question for the casuists whether this constitutes publication. It will be noted that Bernhardi arrived independently at the same conclusions as Swartz in several cases and his results only lack priority of place; it is also curious to note how Swartz in his later publications systematically sets aside the work of Bernhardi; later investigators have regarded Swartz's conclusions as unjust, and several of the genera of Bernhardi are now being regarded in their true light.

1801

Cavanilles (Icon. et Descr. Pl. 73)† published *Ugena* based on *U. semihastata, U. dichotoma, U. macrostachya, U. polymorpha*, and *U. microphylla*, thus forming another generic name for *Lygodium*. Later on Cavanilles and likewise Swartz‡ quote this paper as published in October 1801.

1801

Cavanilles (Description de las Plantas §) established the genera: 1. *Tectaria* (249) based on *Polypodium phymatodes, P. trifoliatum,*

* This has nothing to do with *Sphaeropteris* Wall. recognized in Synopsis Filicum as a valid genus.

† Anal. de Cienc. 6:

‡ Synopsis Filicum, 152. 1806.

§ Swartz quotes this portion of the work under the citation "Prael." with the date 1801. As it cites (p. 282) the generic name *Ugena*, which, according to both Swartz and Cavanilles himself, appeared in October, 1801, this portion of the work must have

P. filix-mas, *P. filix-foemina* and other species described as new from Spanish colonies; 2. *Oleandra* (252) based on a single species, *O. neriiformis*; and 3. *Humata* (272) based on three species described by Cavanilles from the Marian Isles, *viz. H. ophioglossa*, *H. pinnatifida* and *H. trifoliata*.

1802

Bernhardi (Schrader's Journ. 1801[1]: 22) founded the genus *Calypterium* based on *Onoclea sensibilis* L.

1802

Cavanilles (Generos y especies de plantas demonstradas en las lecciones publicas del año de 1802*) established two additional genera: *Clementea* (553) based on a single species from the Marian Isles, which is evidently the exact synonym of *Angiopteris evecta*; and *Aphyllocalpa* (556) based on *Osmunda regalis*, the genus *Osmunda* being reserved for *O. Lunaria* and other species of *Botrychium*, as had been done by Bernhardi a year earlier. In his summary at the close of the work he recognizes twenty-eight genera of ferns.

1802

Willdenow (Act. Acad. Erford. 14 †) established the genera *Todea*, based on *Acrostichum barbarum* L., and *Hydroglossum*, based on *Ophioglossum scandens* L. and seven other species.

1802

Mirbel established the genus *Ramondia* based on *R. flexuosa* and *R. scandens*. The only reference to this publication we have

appeared late in the year 1801, if, indeed, it was not issued early in 1802, the date cited by Moore for these genera. Pp. 285–625 evidently appeared later in 1802. The "Prologo" dated 1 March, 1802, and the "Principios elementales de Botanica" (pp. vii–cxxxvi) may have appeared between the other two, or possibly earlier than both. In the two copies we have seen, viz., those at the libraries of Columbia University and Kew Herbarium, the title page is dated 1827, but this evidently has nothing to do with the text of the book itself, and, according to Pritzel, belongs merely to the reprint edition of the work. The full title of the work is "Description de las plantas que D. Antonio Josef Cavanilles demonstro en las lecciones publicas del año 1801 precedida de las principios elementales de la botanica."

* Forming a part (pp. 285–625) of the book mentioned in the last footnote in the two copies we have seen.

† This paper was read 3d Feb. 1801. It was published as a separate together with a paper by Bernhardi under the title: "Ueber einige seltene Farrenkräuter und über Asplenium und einige ihm verwandte Gattungen. Mit 4 Kupfertafeln. Erfurt, 1802."

been able to discover is a note on a "Memoire sur Ramondia, nouveau genre de fougére par le C. Mirbel," signed "DC." in Bull. de Sciences par la Soc. Philomatique de Paris 2: 179, "an 9" no. 47. This publication would be sufficient for the genus, which is only another synonym of *Lygodium*.

1803

Richard (in Michaux: Fl. Bor. Am. 2:) established the genera: *Nephrodium* (266)* based on *N. acrostichoides, N. thelypteroides, N. marginale, N. punctilobulum, N. bulbiferum, N. filix-foemina, N. asplenioides, N. cristatum, N. tenue, N. rufidulum, N. lanosum* and *N. Dryopteris: Botrypus* (274)† based on *B. Virginicus* and *B. lunarioides;* and *Cteisium* (275) based on *C. paniculatum* (*Lygodium palmatum*). He also established a sub-genus *Hypopeltis* (266) without naming a type.

1803

Mirbel (Hist. Nat. Veg. 5: [ed. Deterv.]) established the genera *Candollea* (86) based on four species of which *C. heterophylla* (*Acrostichum heterophyllum* L.) is first named; *Pyrrhozia* (91) based on *P. Chinensis* Mirbel; *Riedlea* (71) based on *R. sensibilis* (*Onoclea*); and *Belvisia* (111) based on five species of which *Acrostichum spicatum* L. is first mentioned.

1804

Willdenow (Act. Holm. 165) established the genus *Mertensia* based on five species of which *M. furcata* from Jamaica is first named. Since this group is distinct from *Gleichenia* it is unfortunate that this generic name is preoccupied, there being a previous *Mertensia* (Roth, 1797) in the Borraginaceae.

1804

Bory (Voy. 1: 282, note 2) published *Callipteris* based on *Asplenium proliferum* Encyc. Dict. with the statement: "Cette plant doit former avec quelques autres un genre nouveau," but in his enumeration he gives four species in the following order: 1. *C. castaneifolia*, 2. *C. sylvatica*, 3. *C. prolifera*, 4. *C. arborescens*.

* It will here be seen how utterly illogical it has been to apply this name to a group of ferns with united veins.

† Richard quotes "Hort. Med. Paris. Cat." which I have not seen. An MS?

This is a case where a proper exception may be made to the rule of accepting the first name cited under the genus as the type, since a definite type was previously mentioned by the author of the genus in the description.

1804

Sprengel (Anleitung, 3:) described several species in various previously established genera of which he recognized thirty-two, but established no new ones.

1806

Bernhardi (Schrader's Neues Journ. 1[2]:) published the following genera: 1. *Cystopteris* (26) based on *Aspidium fragile*, *A. montanum*, and *A. bulbiferum*; 2. *Hypolepis* (34) based on *Lonchitis tenuifolia* Forst.; 3. *Allosorus* (36) based on "Alle Adianta spuria Sw.;"* *Dicranopteris* (38) based on *Polypodium dichotomum*; and 4. *Ornithopteris* (40)† founded on certain *Osmundae* "welch einen gyrus spurius besetzen," of which *O. hirsuta* and *O. adiantifolia* are mentioned.

1806

Swartz published his *Synopsis Filicum* which was the first completed systematic review of the ferns of the world.‡ Swartz'

* The "Adianta spuria" of Swartz (Schrader's Journ. 1801) are *A. viride* (*Pteris serrulata* Forsk.), *A. [illegible]* Law (Plumier, pl. 55), *A. fragrans* (*Polypodium fragrans* L. mant.), *A. capillus* Law L., *A. pentadactylon* Sw., *A. Caffrum* Thumb., *A. flexuosum* L., *A. tenuifolium* Law (*Pteris tenuifolia* Forst.) and *A. multifidum* Sw., all of which except *A. capillus* Law form members of the genus *Cheilanthes* published the same year. It is very evident that Bernhardi's paper appeared in the interval between the printing of the genus *Cheilanthes* in Swartz' Synop. Fil. (p. 126) and the printing of the index (p. 425), which says "*Cheilanthes* Bernh. est *Cheilanthes*." In so close and complicated a case as this it would seem reasonable to let the genus *Cheilanthes* stand, especially since *Pteris serrulata* Forsk., the first named species under *Adiantum*, is not a *Cheilanthes*. For the same reason *Cheilanthes* must hold as a good genus. How Moore and others could transfer this name to *Cheilanthes tenuifolia* and *Pteris Sieberi*, species never included in this genus by Bernhardi, is one of the many anomalies into which a lack of system in systematic work has brought us.

† This is also a correct use of the name of Swartz' Synopsis Filicum as "*Ornithopteris* Bernh. est *Ornithopteris*." It would seem that this name *Ornithopteris* should stand, particularly as it is a very distinct section of the composite genus which has hitherto been known under the good name

‡ There is no common basis of reference for the work which was commenced by Linnaeus in 1753 in the 2 [illegible] Species Plantarum and [illegible] 1806. He described 2,144 species; Swartz described 7,117 species besides citing many as yet unnamed, together with 68

personal work was based on collections in Jamaica, etc., which had been described by him either in the Prodromus (1788) or his Flora Indiae Occidentalis (1806). The work was edited and annotated by Weber and Mohr. Swartz recognized 38 genera besides three of the Lycopodiaceae of which the following were new: 1. *Taenitis* Willd. (24) founded on *Pteris blechnoides* Willd. 2. *Cheilanthes* (126) based on sixteen species of which *C. micropteris* is first named. 3. *Anemia* (155) based on seventeen species of which *Osmunda phyllitidis* L. is first named. 4. *Mohria* (159) based on *Adiantum Caffrorum* L. which is rebaptized as *Mohria thurifraga;* and 5. *Psilotum* (187) based on *Lycopodium nudum* L. which is rebaptized as *P. triquetrum.*

1809

Willdenow (Berliner Mag. 160) founded the genus *Struthiopteris** based on *Osmunda Struthiopteris* L. "und eine neue noch nicht beschriebene aus Pennsylvanien;" and the genus *Lomaria* based on "Alle von Swartz angeführte Arten, ausser den bereits davon eben getrennten werden, nur dessen *Onoclea Sorbifolium* ist ein wahres *Acrostichum.*" As the reference is to Swartz' *Synopsis Filicum*, *Lomaria* must stand for *O. spicata, O. nodulosa* Mx., *O. discolor, O. Capensis, O. lineata, O. Boryana, O. attenuata* and *O. scandens*, as the residue in the order named by Swartz.

1809

Schkuhr (Crypt. Gewächse, 82) published the genus *Monogramma* Commerson, based on *M. graminea* from Bourbon and figured on *pl. 87* under "*Cenopteris?*"

1810

R. Brown (Prodr. Fl. Nov. Holl. 1:) established the following genera: 1. *Notholaena*† (145) based on five species of which *N. distans* is first mentioned; a "genus cujus lupus *Poly. umbrosum*

* This is the third time this generic name was used, *Cf.* 1760, Scopoli, and 1801, Bernhardi above.

† The orthography *Nothochlaena* has been followed by many but Robert Brown wrote the name as above. It is passing strange that with the copy of the Prodromus in hand, Mr. Baker could say of *Nothochlaena* "The above is the original spelling of the name as given by R. Brown." *Cf.* Annals Bot. 5: 480 (New Ferns, 98).

Hort. Kew, alias sp. ineditas continet." 2. *Allantodia** (149) based on *A. australis* and *A. tenera.* 3. *Doodia* (151) based on *D. aspera, D. media* and *D. caudata.* 4. *Stegania* (152) based on eight species of which *S. Patersoni* is first named; the species are included under *Lomaria* by Baker. 5. *Alsophila* (158) based on *A. australis.* 6. *Platyzoma* (160) based on *P. microphyllum.* In a footnote under *Alsophila, Hemitelia* (158) is proposed for *Cyathea multiflora* Swz., *C. horrida* and *C. Capensis,* and in a second footnote for *Polypodium Ilvense* and *P. hyperborea, Woodia* (sic) is proposed.

1810

Humboldt and Bonpland (see 1810 under Willdenow).

1810

Willdenow published the fourth edition of *Systema Plantarum* of which Vol. 5 contains the ferns in which 43 genera and 1008 species are recognized; the new genera are: 1. *Ceterach* (136) based on three species of which *C. officinarum* is first named, a changed form of the name of a genus, long before adopted from Tournefort by Adanson; 2. *Pleopeltis* H. & B. (211), based on *P. angusta;* and 3. *Polybotra* H. & B. (99) based on *P. osmundacea.*

1811

Desvaux (Berliner Mag. 5:) established the following genera:

1. *Didymochlaena* (393) based on *D. sinuosa* Desv. from India orientalis.

2. *Gymnogramma* (304) based on *G. rufa* (*Pteris rufa*) from Jamaica and twelve other species.

3. *Cincinalis* (311) based on *C. ferruginea* Desv. of the Antilles and eleven others.

4. *Cyclophorus* (300) based on *C. adnascens* (*Poly. adnascens* Swz.) and five others.

These were repeated in the Jour. de Bot. 1813.

* The inconsistencies of English systematists are forcibly illustrated here; this genus of two species has been returned to *Asplenium* while the generic name has been transferred to *A. Brunoniana,* and the genus ascribed to Wallich! *Cf.* Synopsis Filicum 246, and Moore's Index Filicum, 42.

1811

Aub. du Petit Thours (Melanges de Botanique, 1:) founded the genus *Scyphofilix* with no type mentioned, but described as follows: "Involucrum calicinum cupuliforme, continens plurimas capsulas annulatas, disco folii inferiore adnatum frons decompositas. An *Davallia* Smith?;" and *Vallifilix* based on *Ophioglossum scandens*. The author considers it necessary to establish this last genus as new, altho he quotes *Lygodium* Swz., *Ugena* Cav., *Odontopteris* Bernh., *Ramondia* Mirbel, and *Hydroglossum* Willd. as synonyms most of which were founded on exactly the same type! If ever a genus was overburdened with synonyms it is the genus *Lygodium*; almost every writer on ferns in the first decade of this century gave it a new name.

1813

R. Brown (Trans. Linn. Soc. 11: 173) republished* the genus *Woodsia* based on *W. Ilvensis* and *W. hyperborea*, the latter needlessly coined by Swartz, as both he and R. Brown cite *Acrostichum alpinum* Bolton as the original name.

1816

Lagasca (Gen. et Sp. Pl. 33) established the genus *Llavea* based on *L. cordifolia* from Nova Hispania.

1819

Raddi (Op. Sc. di Bol. 3:) founded the genera *Olfersia* (283, *pl. 6*) based on *O. corcovadensis* from Brazil and *Rumhora*† (290, *pl. 12. f.*) founded on *R. aspidioides* from Brazil.

1820

Kaulfuss (Berl. Jahrb. Pharm.‡) established the following genera: 1. *Xiphopteris* (35) based on *Grammitis serrulata* and *G. myosuroides* from Jamaica; 2. *Cochlidium* (36) based on *Grammitis graminoides* Swz. from Jamaica; 3. *Onychium* (45) founded on "nur eine Art vom Vorgeberge der guten Hoffnung"; since

* Prodr. Fl. Nov. Hall. 1: 158, note. 1810.

† Evidently a misprint for *Rumohra* as it was named for C. de Rumohr.

‡ The only file of this curious journal which we have been able to find is in the library of the Surgeon General's office at Washington.

no type is mentioned this genus must be cited from 1824; 4. *Saccoloma* (51) based on *S. elegans* from Brazil; and 5. *Cibotium* (53) based on *C. Chamissoi* from the "Südsee."

1821

Brongniart (Bull. Soc. Phil.) founded the genus *Ceratopteris* (186) with two species (1) *Ceratopteris thalictroides* founded on *Pteris thalictroides* Sw. ((a) *Acrostichum siliquosum* and (b) *A. thalictroides* L.) and (2) *Ceratopteris Gaudichaudii* from the Marian Is.

1821

S. F. Gray (Nat. Arr. Brit. Plants, **2**: 9) founded the genus *Cyclopteris* based on *C. fragilis* (= *Filix*).

1822

Presl (Deliciae Pragenses) establishes the genus *Trichipteris* (172) on *T. excelsa* from Brazil. Later he changed the name to *Trichopteris.*

1823

R. Brown (App. Franklin's Journ. 767) established the genus *Cryptogramma* based on *C. acrostichoides;* and *Teleozoma* based on *Pteris thalictroides* Swz. which he had recognized as a good genus thirteen years before but unfortunately had suggested no name.

1824

Kaulfuss (Enumeratio Filicum) published the results of Chamisso's journeys and established the following genera of ferns: 1. *Helmithostachys* (28) founded on *H. dulcis* (*Osmunda Zeylanica* L.); 2. *Chnoophora* (123) based on *C. Humboldtii* Kaulf. (*Cyathea villosa* H. & B.); 3. *Niphobolus* (124) substituted for *Cyclophorus* Desv., because the latter was preoccupied in conchology, based on *N. adnascens* (*Polypodium adnascens*) and six other species; 4. *Hymenolepis* (146) based on *H. ophioglossoides* (*Acrostichum spicatum*); 5. *Leptochilus* (147) based on *L. axillaris;* 6. *Ellobocarpus* (147) based on *E. oleraceus* (*Ceratopteris*); 7. *Sadleria* (161) based on *S. cyatheoides* Kaulf. from the Hawaiian Islands. 8. *Antrophyum* (197) based on *A. pumilum* (*Hemionitis immersa* Willd.), *A. plantagineum* (*Hemionitis plantagineum* Cav.), and three others; 9. *Cas-*

sebeera (215) based on *Adiantum triphyllum* and *C. pinnata* Kaulf.; 10. *Balantium* (228) based on *B. auricomum* and *Dicksonia Culcita.* Besides the above, *Onychium* (144) must be reckoned from this date since it was not fully established by its author in 1820. (*O. auratum* and *O. Capense* are here described.)

1824

Gaudichaud (Ann. Sci. Nat. 3:) established *Pinonia* (507) based on *P. splendens* from the Sandwich Islands; *Schizoloma* (507) based on *S. cordatum* from the Moluccas and two other species, and *Adenophorus* (508) based on *A. tripinnatifida* from the Sandwich Islands and two other species.

1824

Bory (Dict. Class. Hist. Nat. 6–9:) founded the genera:

1. *Feea* (6: 446, 588. 1824) based on *F. polypodina* and *F. nana.*

2. *Hymenostachys* (6: 588. 1824; 8: 462. 1825) based on *H. diversifrons.*

3. *Lastrea* (6: 588. 1824; 9: 232. 1826) based on *Polypodium Oreopteris, Thelypteris, Phegopteris,* and *Dryopteris* of Europe together with other species.

4. *Selliguea* (6: 587. 1824; 15: 344. 1829) based on a Javan species described but not named.

5. *Marginaria* (*Adenophorus* Gaud.) (6: 587. 1824; 10: 176. 1826) based on *M. scolopendria, Poly. marginatum* Willd., *P. incanum* and two others.

1825

Bory (Ann. Sci. Nat. 5: 464) established *Drynaria* as a subgenus based on *Polypodium quercifolium* L. and three other species.

1825

Hamilton (in Don: Prod. Fl. Nep.) published:

1. *Neuronia* (6) based on *Aspidium Wallichii* Hook. Exot. Fl. *pl. 5,* changed to *N. asplenoides* (7).

2. *Peranema* (12) founded on *P. cyatheoides.*

3. *Leptostegia* (14) on *L. lucida.*

1825

Hooker (Exotic Flora 2: 147) established the genus *Parkeria* based on *P. pteridoides* from Guiana, apparently in ignorance of the genus *Ceratopteris* established four years previously, and *Teleozoma* in which Robert Brown had antedated him by two years.

1825

Reinwardt (Syll. Pl. Regensb.*) published:

Onychium (2) based on *O. carnosum.*

Dipteris (3) based on *D. conjugata.*

Ophiopteris (3) based on *O. verticillata.*

Tegularia (3) is proposed by Hornschuch as a substitute for *Ceramium* Reinw. based on *T. adiantifolia* (*Aspidium truncatulum* Swz., Willd.).

Ceramium (3) preoccupied (= *Tegularia* Hornsch.).

1826

Gaudichaud (Freycinet's Voy.) published:

1. *Alcicornium* (307) based on *A. vulgare.*

2. *Monochlaena* (340) based on *M. sinuosa* a needless synonym for *Didymochlaena.* "*Hippodium* Gaud. MS." is also published as an additional synonym.

Adenophorus, Pinonia and *Schizoloma* are further characterized altho they were originally published two years earlier.

1827

Eschweiler (Linnaea 2: 117) established the genus *Poikilopteris* on *Acrostichum scandens* Raddi, the form of which was changed to *Poecilopteris* later by Presl and others.

1827

Desvaux (Ann. Soc. Linn. Paris, 6:) published a long account of the known ferns† with many new species and the following new genera:

* Often quoted as Syll. Ratisbon, and published in the Bot. Zeitung (Flora) as one of the early miscellaneous papers of that serial.

† We have recently received a copy of this paper in the original covers, which bears the title *Prodrome de la famille des Fougères;* pp. 171–212 bear the date "Ma 1827" and pp. 213–337 bear the date "Juillet 1827." The text calls for plates 7–11 but only 7 and 8 are present, as is also the case with the copy in the Kew Herbarium, the only other copy seen.

1. *Ophiala* (195) based on *O. Zeylanica* (*Osmunda Zeylanica* L.).

2. *Platycerium* (213) based on *P. alcicorne* and three other species.

3. *Micropteris* (217) based on *M. blechnoides* (*Blechnum seminudum* Willd.), *M. serrulata*, *M. orientalis* Desv. and *M. pectinata* Desv.

4. *Polytaenium* (218) based on *P. lanceolatum* (*Hemionitis lineata* Swz.).

5. *Pteropsis* (218) based on *P. nummularia* (*Acrostichum heterophyllum* L.) and nine other species.

6. *Sitobolium* (263) based on *S. punctilobum* (*Nephrodium punctilobum* Michx.).

7. *Phorolobus* (291) based on *P. crispus* (*Osmunda crispa* L.) and four other species.

8. *Furcaria* (292) based on *F. thalictroides* (*Acrostichum thalictroides* L.) and *F. cornuta* (*Pteris cornuta* Beauv.).

9. *Neuropteris* (292) based on *N. elegans* Desv. from British Guiana.

10. *Didymoglossum* (330) based on *Trichomanes muscoides* and seven others.

11. *Amphoradenium* (335) substituted for *Adenophorus* Gaud. and based on *A. Gaudichaudii* (*Adenophorus tripinnatifida* Gaud.).

1828

Blume (Enum. Pl. Jav. 2:)* established the following genera: 1. *Lecanopteris* (120) based on *L. carnosa* from the Moluccas; 2. *Stenogramma* (172) based on *S. aspidioides*; 3. *Arachnoides* (241) based on *A. aspidioides*; 4. *Diacalpe* (241) based on *D. aspidioides*; 5. *Gymnosphaera* (242) based on *G. glabra* and *G. squamulata*; 6. *Kaulfussia* (260) based on *K. aesculifolia*. *Paragramma* (119) and *Diagramma* (118) were also published as subgenera of *Grammitis*.

1828

Hooker and Greville (Icones Filicum, *pl. 154*) established the genus *Deparia* based on *Deparia Macraei* from Owhyhee (Hawaii).

* A revised edition was issued in 1830 apparently with the same pagination.

1828

J. E. Smith (Engl. Flora, 4: 258) established the genus *Cystea* founded on *C. fragilis* and three other British species, and thus introduced the practice of arbitrarily discarding a name already established, "a retrenching of the genus *Cystopteris* Bernhardi as compounded of another already established, *Pteris*, neither the genus or [*sic*] its name having ever been received, such a necessary correction can cause no inconvenience." It is a sufficient condemnation of this egotistic assumption to note that the name *Cystea* has received the merited oblivion it deserves and only its mummy remains in synonymy to remind us that justice in nomenclature is sometime sure to come!

1828

Wallich (*fide* Sprengel: Gen. Pl. 724) established *Arthrobotrys* as a subgenus of *Aspidium* based on *A. Thelypteris* and several other species. Pfeiffer dates the genus 1831. In his catalogue (1832) he established *Actinostachys* based on *Schizaea digitata.*

1828

Blume (Fl. Javae, 2:*) established *Pleurogramme* (69), based on *Taenitis linearis* Kaulf., *T. pinnata* Kaulf. and *T. graminifolia* Hook.; *Cheilogramme* (70), based on *T. lanceolata* Kaulf., *T. angustifolia* Spreng., *T. furcata* Willd., and *T. tricuspidata* Spreng.; Loxogramme (73), as a subgenus of *Grammitis* based on *G. lanceolata* Swz., *G. coriacea* (Kf.) Spreng., *G. avenia* Blume, and *G. involuta* Don. Under *Polypodium* he also establishes the § *Goniophebium* (132), based on *P. cuspidatum, P. subauriculatum* and ? *P. pallens*; and § *Ctenopteris* (132) based on seven species of which *P. Celebicum* is first named.

1829

Kaulfuss (Flora, 12[1]: 341) established the genus *Physematium* based on *P. molle* from Mexico, a genus, perhaps, needlessly separated from *Woodsia.*

* The copy of this folio in the Columbia University bears the double date "1828–36" but the genera are usually assigned to the earlier date whether correctly we cannot say.

1830

R. Brown (in Wallich: Pl. Asiat. rarior. 1:) established the genus *Matonia* (16. *pl. 16*) based on *Matonia pectinata;* the name *Hypoderris* is mentioned as follows: "The beautiful ramification of the veins and their union from which the sorus originated in *Matonia* is not altogether peculiar to it. Among those genera of Polypodiaceae having an indusium one remarkable example occurs in a genus as yet undescribed (*Hypoderris*) which with an indusium not materially different from that of *Woodsia* has exactly the habit of *Aspidium trifoliatum.*" This is all the basis that exists for assigning the name of Robert Brown and affixing the date 1830 to the genus *Hypoderris*, yet some people who accept this, reject other genera admittedly just as distinct which were elaborately described by their authors, and moreover referred to well-known species as types.

1830

Presl (Reliquae Haenkeanae, 1: 76. *pl. 12. f. 1*) established the genus *Botryopteris* based on *B. Mexicana*, based, as afterwards stated by the author, on an erroneous label, as the plant figured is a species of the East Indian genus *Helminthostachys.*

1831

Hooker and Greville (Icones Filicum, *pl. 178*) established the genus *Jamesonia* based on *J. pulchra* from Peru.

Summary

The genera of ferns proposed prior to 1832 with their type species and synonyms arranged alphabetically are the following:

(Genera with claims to validity are in **bold face**; synonyms are in SMALL CAPITALS; the type of each genus follows the date in *Italics*; dead names are in Roman.)

Achomanes Neck, 1790 (no type).
Acrostichum L., 1753 (*A. aureum*).
Actinostachys Wall., 1832 (*Schizaea digitata*).
ADENOPHORUS Gaud., 1824 = Polypodium.
Adiantum L., 1753 (*A. capillus-Veneris*).
Alcicornium Gaud., 1826 (*A. vulgare*).
PLATYCERIUM Desv., 1827 (*P. alcicorne*).

ALLANTODIA R. Br., 1810 = Athyrium.
Allosorus Bernh., 1806 (*Pteris viridis* Forsk.).
Alsophila R. Br., 1810 (*A. australis*).
CHNOOPHORA Kaulf., 1824 (*C. Humboldtii*).
TRICHIPTERIS Presl, 1822 (*T. excelsa*).
GYMNOSPHAERA Blume, 1828 (*G. glabra*).
AMPHORADENIUM Desv., 1827 = Polypodium.
Anemia Swz., 1806 (*Osmunda phyllitidis* L.).
ANGIOPTERIS Adans., 1763 = Onoclea.
Angiopteris Hoffm., 1793 (*Polypodium erectum* Forst.).
CLEMENTEA Cav., 1802.
Antrophyum Kaulf., 1824 (*Hemionitis immersa* Willd.).
APHYLLOCALPA Cav., 1802 = Osmunda.
Arachnoides Blume, 1828 (*A. aspidioides*) = Polystichum *fide* Hooker.
ARTHROBOTRYS Wall., 1828 = Dryopteris.
Aspidium Swz., 1800 (*A. articulatum*).
OLEANDRA Cav., 1802 (*A. neriiformis*).
NEURONIA Ham., 1825 (*Aspidium Wallichii*).
Asplenium L., 1753 (*A. ceterach*).
CETERAC Adans., 1763 (*C. officinarum*).
CETERACH Willd., 1810 (*C. officinarum*).
Athyrium Roth, 1800 (*A. fontanum*).
ALLANTODIA R. Br., 1810 (*A. australis*).
Balantium Kaulf., 1824 = *B. auricomum.*
Belvisia Mirb., 1803 (Acrostichum spicatum).
LOMARIA Willd., 1809 (Onoclea spicata).
HYMENOLEPIS Kaulf., 1824 (Acrostichum spicatum).
Blechnum L., 1753 (*B. orientale*).
Botrychium Swz., 1800 (*B. lunaria*).
LUNARIA Hill, 1756, not L. 1753.
BOTRYPUS Richard, 1803 (*B. Virginicus*).
BOTRYOPTERIS Presl, 1830 = Helminthostachys.
BOTRYPUS Richard, 1803 = *Botrychium.*
Caenopteris Berg., 1782 (*C. furcata*).
Callipteris Bory., 1804 (*Asplenium proliferum*).
CALYPTERIUM Bernh., 1802 = Onoclea.

Candollea Mirbel, 1803 (*Acrostichum heterophyllum* L.).
PTEROPSIS Desv., 1827 (*P. nummularia* = *Acrostichum heterophyllum* L.).
Cassebeera Kaulf., 1824 (*Adiantum triphyllum*).
Celanthera Thouin, 1786 (?? = Marattia).
CERAMIUM Reinw., 1825 = Didymochlaena.
Ceratopteris Brongn., 1821 (*C. thalictroides*).
TELEOZOMA R.Br., 1823 (*Pteris thalictroides* !).
ELLOBOCARPUS Kaulf., 1824 (*E. oleraceus* = *Ceratopteris thalictroides*).
PARKERIA Hook., 1825 (*P. pteridoides* !).
FURCARIA Desv., 1827 (*Acrostichum thalictroides*).
CETERAC Adans., 1763 = Asplenium.
CETERACH Willd., 1810 = Asplenium.
Cheilanthes Swz., 1806 (*C. micropteris*).
Cheilogramme Blume, 1828 (*Taenitis lanceolata*).
CHNOOPHORA Kaulf., 1824 = Alsophila R. Br.
Cibotium Kaulf., 1820 (*C. Chamissoi* !).
PINONIA Gaud., 1824 (*P. splendens*).
Cincinalis Gled., 1764 (no type).
CINCINALIS Desv., 1811 = Notholaena R. Br.
CLEMENTEA Cav., 1802 = Angiopteris Hoffm.
COCHLIDIUM Kaulf., 1820 = Monogramma.
Cryptogramma R. Br., 1823 (*C. acrostichoides* !).
PHOROLOBUS Desv., 1827 (*Osmunda crispa* L.).
CTEISIUM Richard, 1803 = Lygodium.
Ctenopteris Blume, 1828 = § Polypodium.
Cyathea J. E. Smith, 1793 (*Polypodium horridum* L.).
Cyclophorus Desv., 1811 (*Polypodium adnascens* Swz.).
NIPHOBOLUS Kaulf., 1824 (*P. adnascens*).
CYCLOPTERIS S. F. Gray, 1821 = Filix.
CYSTEA J. E. Smith, 1828 = Filix.
CYSTOPTERIS Bernh., 1811 = Filix.
Danaea J. E. Smith, 1793 (*Asplenium nodosum* L.).
Darea Juss., 1789 (no type).
Davallia J. E. Smith, 1793 (*D. Canariensis*).

Dennstaedtia Bernh., 1800 (*Trichomanes flaccida* Forst.).
SITOBOLIUM Desv., 1827 (*Nephrodium punctilobulum* Michx.).
Deparia Hook. & Grev., 1828 (*D. Macraei*).
Diacalpe Blume, 1828 (*D. aspidioides*).
Diagramma Blume, 1828 = § Grammitis Swz.
Dicksonia L'Her., 1788 (*D. arborescens*).
Dicranophlebia Mart., 1828–1834 = sub-genus Alsophila.
Dicranopteris Bernh., 1806 (*Polypodium dichotomum*).
MERTENSIA Willd., 1804 (*M. furcata*).
Didymochlaena Desv., 1811 (*D. sinuosa*).
CERAMIUM Reinw, 1825. Not Wiggers, 1780, nor Agardh, 1817.
TEGULARIA Hornsch., 1825 (*Aspidium truncatulum* Swz.).
MONOCHLAENA Gaud., 1826 (*M. sinuata*).
HIPPODIUM Gaud. MS. 1826 (quoted as synonym of *Monochlaena*).
DIDYMOGLOSSUM Desv., 1827 = Trichomanes.
Diplazium Swz., 1800 (*Asplenium plantagineum* L.).
Dipteris Reinw., 1825 (*D. conjugata*).
Doodia R. Br., 1810 (*D. aspera*).
Drynaria Bory., 1825 (*Polypodium quercifolium* L.).
Dryopteris Adans., 1763 (*Polypodium filix-mas*).
LASTREA Bory., 1824 (*Polypodium oreopteris*).
ARTHROBOTRYS Wall., 1828 (*Aspidium Thelypteris*).
ELLOBOCARPUS Kaulf., 1824 = Ceratopteris.
Feea Bory., 1824 (*F. polypodina*).
Filix Adans., 1763 (*Polypodium bulbiferum*).
CYSTOPTERIS Bernh., 1806 (*Aspidium fragilis*).
CYCLOPTERIS S. F. Gray, 1821 (*C. fragilis*).
CYSTEA J. E. Smith, 1828 (*C. fragilis*).
FURCARIA Desv., 1827 = Ceratopteris.
GISOPTERIS Bernh., 1800 = Lygodium.
Gleichenia Neck., 1790 (no type).
Gleichenia J. E. Smith, 1793 (*Onoclea polypodioides* L.).
Goniophlebium Blume, 1829 = § Polypodium.
Grammitis Swz., 1800 (*G. linearis*).
GYMNOGRAMMA Desv., 1811 = Gymnopteris Bernh.

Gymnopteris Bernh., 1799 (*Acrostichum rufum* L.).*
GYMNOGRAMMA Desv., 1811 (*Pteris rufa*).
GYMNOSPHAERA Blume, 1828 = Alsophila.
Haplophlebia Mart., 1828–34 = sub-genus Alsophila.
Helminthostachys Kaulf., 1824 (*Osmunda Zeylanica* L. !).
OPHIALA Desv., 1827 (*O. Zeylanica* !).
BOTRYOPTERIS Presl., 1830 (*B. Mexicana*).
Hemionitis L., 1753 (*H. palmata*).
Hemitelia R. Br., 1810 (*Cyathea multiflora* Swz.).
HIPPODIUM Gaud., 1826 = Didymochlaena !
Humata Car., 1801 (*H. ophioglossa*).
HYDROGLOSSUM Willd., 1802 = Lygodium.
HYMENOLEPIS Kaulf., 1824 = Belvisia Mirbel.
Hymenophyllum J. E. Smith, 1793 (*Trichomanes Tunbridgense* L.).
PTYCHOMANES Hedw., 1800 (*Trichomanes asplenoides* Swz.).
WIBELIA Bernh., 1801 (*Trichomanes Tultifidum* Forst.).
Hymenostachys Bory., 1824 (*H. diversifrons !*).
HYMENOTOMIA Gaud., 1826 = Lindsaea.
Hypoderris R. Br., ? 1830 (established later than 1831).
Hypolepis Bernh., 1806 (*Lonchitis tenuifolia*).
Hypopeltis Richard, 1803 (no type).
Jamesonia Hook. & Grev., 1831 (*J. pulchra*).
Kaulfussia Blume, 1828 (*K. aesculifolia*).
LASTREA Bory., 1824 = Dryopteris.
Lecanopteris Blume, 1828 (*L. carnosa !*).
ONYCHIUM Reinw., 1825 (*O. carnosa*).

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* The recent Lieferungen of Engler-Prantl, *Die natürlichen Pflanzenfamilien*, relating to the ferns, have reached us just before the last page proofs of this article were returned to the printer, and while giving us in the main a much more rational classification of the ferns, still contain many interesting muddles which amply illustrate the lack of system among taxonomists who follow a hap-hazard system, or better no system at all in the matter of generic types. A single instance will sufficiently illustrate this point. As noted above *Gymnopteris* Bernh. was based on a single species (*Acrostichum rufum* L.). Now in *Die natürlichen Pflanzenfamilien* "*Gymnopteris* Bernh." appears (pp. 198–202) as a large tropical genus of thirty species, but the only species known to Bernhardi and the one on which he founded the genus does not appear among them! On the contrary, *Acrostichum rufum* L., which stood as the monotype of Bernhardi's *Gymnopteris* in 1799, and headed the list of the dozen species which Desvaux in 1811 marshalled under his new genus *Gymnogramma*, appears in this most recent utterance of the Berlin code under neither of these genera, but with other species under *Neurogramme* (p. 262, *f. 139 B*), a genus founded by Link in 1844!!! Surely some taxonomists have yet to learn the fundamental principles of stability in nomenclature!

Leptochilus * Kaulf., 1824 (*L. axillaris!*).
Leptostegia Ham., 1825 (*L. lucida*).
Lindsaea Dry.; J. E. Smith, 1793 (*Adiantum Guianense* Aubl.).
HYMENOTOMIA Gaud., 1826 (*Lindsaea microphylla*).
Llavea Lag., 1816 (*L. cordifolia*).
LOMARIA Willd., 1809 = Belvisia Mirb.
Lonchitis L., 1753 (*L. aurita*).
Lophidium Richard, 1792 (*L. latifolium*).
RIPIDIUM Bernh., 1801 (*Acrostichum dichotomum*).
Loxogramma Blume, 1828 = § Grammitis.
Lygodium Swz., 1801 (*Ophioglossum scandens* L.).
ODONTOPTERIS Bernh., 1801 (*O. scandens*).
GISOPTERIS Bernh., 1801 (*Hydroglosum palmatum*).
UGENA Cav., 1801 (*U. semihastata*).
HYDROGLOSSUM Willd., 1802 (*Ophioglossum scandens*).
RAMONDIA Mirbel, 1802 (*R. flexuosa*).
CTESIUM Richard, 1803 (*C. paniculata* = *Lygodium palmatum*).
VALLIFILIX Aub. du Petit Thours, 1811 (*Ophioglossum scandens*).
Marattia Swz., 1788 (*M. alata!*).
MARGINARIA Bory., 1824. = Polypodium.
Matonia R. Br., 1830 (*Matonia pectinata*).
Meniscium Schreb., 1791 (*Polypodium reticulatum* L.).
MERTENSIA Willd., 1804 = Dicranopteris.
Micropteris Desv., 1827 (*Blechnum seminudum* Willd.).
Mohria Swz., 1806 (*Adiantum Caffrorum* L.!).
MONOCHLAENA Gaud., 1826 = Didymochlaena.
Monogramma Commerson, 1809 (*M. graminea*).
COCHLIDIUM Kaulf., 1820 (*Grammitis graminoides!*).
Myriotheca Comm., 1789 (no type). (? = Marattia).
NEPHRODIUM Richard, 1803 = Polystichum.
NEURONIA Ham., 1825 = Aspidium.
NEUROPTERIS Desv., 1827 = Saccoloma.

* The status of this genus is uncertain. Mettenius refers it to *Polypodium*, Hooker to *Acrostichum*, while Moore refers it to *Gymnopteris* which name he adopts from Bernhardi without warrant. Its resting place is thus uneasy and it is quite possible that it represents a good genus by itself.

NIPHOBOLUS Kaulf., 1824 = Cyclophorus.
Notholaena R. Br., 1810 (*N. distans*).
CINCINALIS Desv., 1811 (*C. ferruginea*).
ODONTOPTERIS Bernh., 1800 = Lygodium:
Oetosis Neck., 1790 (no type).
OLEANDRA Cav., 1802 = Aspidium.
Olfersia Raddi, 1819 (*O. corcovadensis*!).
Onoclea L., 1753 (*O. sensibilis*!).
ANGIOPTERIS Adans., 1763, not Hoffm.
CALYPTERIUM Bernh., 1802 (*Onoclea sensibilis*).
RIEDLEA Mirb., 1803 (*R. sensibilis*).
Onopteris Neck., 1790 (no type).
Onychium Kaulf., 1820 (no type).
Onychium Kaulf., 1824 (*O. auratum*).
ONYCHIUM Reinw., 1825 = Lecanopteris.
OPHIALA Desv., 1827 = Helminthostachys.
Ophioglossum L., 1753 (*O. vulgatum*).
Ophiopteris Reinw., 1825 (*O. verticillata*); referred by Moore to *Oleandra*.
Ornithopteris Bernh., 1806 (*Osmunda hirsuta*).
Osmunda L., 1753 (*O. regalis*).
STRUTHOPTERIS Bernh., 1801 (*Osmunda regalis*); not *Struthiopteris* Scopoli, nor Willd.
APHYLLOCALPA Cav., 1802 (*Osmunda regalis*).
Paragramma Blume, 1828 = sect. Grammitis Swz.
PARKERIA Hook., 1825 = Ceratopteris.
Peranema Hamilton, 1825 (*P. cyatheoides*).
PHOROLOBUS Desv., 1827 = Cryptogramma.
Phyllitis Ludwig, 1757 (*P. Scolopendrium*).
SCOLOPENDRIUM Adans., 1763.
PHYSEMATIUM Kaulf., 1829 = Woodsia.
PINONIA Gaud., 1824 = Cibotium.
PLATYCERIUM Desv., 1827 = Alcicornum.
Platyzoma R. Br., 1810 (*P. microphyllum*).
Pleopeltis H. & B., 1810 (*P. angusta*).
Pleurogramma Blume, 1828 (*Taenitis linearis* Kaulf.).
POECILOPTERIS Presl. = Poikilopteris.
Poikilopteris Esch., 1827 (*Acrostichum scandens* Raddi.)

Polybotra H. & B., 1810 (*P. osmundacea*).
Polypodium L., 1753 (*P. vulgare*).
ADENOPHORUS Gaud., 1824 (*A. triprinnatifida*).
MARGINARIA Bory., 1824 (*M. scolopendria*).
AMPHORADENIUM Desv., 1827 (*A. Gaudichaudii*).
Polystichum Roth, 1800 (*P. Lonchitis*).
NEPHRODIUM Richard., 1803 (*N. acrostichoides*).
RUMOHRA Raddi, 1819 (*R. aspidioides*).
Polytaenium Desv., 1827 (*Hemionitis lineata* Swz.).
Psidopodium Neck., 1790 (no type).
Pteris L., 1753 (*P. arborea*).
THELYPTERIS Adans., 1763 (type indefinite).
PTEROPSIS Desv., 1827 = Candollea Mirb.
PTYCHOMANES Hedw., 1800 = Hymenophyllum.
Pyrrhozia Mirb., 1803 (*P. Chinensis* Mirb.).
Pyxidaria Gled., 1764 (no type) = Trichomanes.
RAMONDIA Mirb., 1801 = Lygodium.
RIEDLEA Mirb., 1803 = Onoclea.
RIPIDIUM Bernh., 1801 = Lophidium.
RUMOHRA Raddi, 1819 = Polystichum.
Saccoloma Kaulf., 1820 (*S. elegans!*).
NEUROPTERIS Desv., 1827 (*N. elegans*).
Sadleria Kaulf., 1824 (*S. cyatheoides!*).
Schizaea J. E. Smith, 1793 (*Acrostichum pectinatum* L.).
Schizoloma Gaud., 1824 (*S. cordatum*).
SCOLOPENDRIUM Adans., 1763 = Phyllitis.
Scyphofilix Aud. de Petit Thouars, 1811 (no type).
Selliguea Bory., 1824 (type not named).
SITOBOLIUM Desv., 1827 = Dennstaedtia.
Sphaeropteris Bernh., 1801 (*Polypodium medullare*).
STEGANIA R. Br., 1810 = Struthiopteris Scop.
Stenogramme Blume, 1828 (*S. aspidioides*).
Struthiopteris Scopoli, 1760 (*Osmunda spicant*).
STEGANIA R. Br., 1810 (*S. Patersoni*).
STRUTHIOPTERIS Willd., 1809 = *Matteuccia Todaro!*
STRUTHOPTERIS Bernh., 1801 = *Osmunda.*
Taenitis Willd., 1806 (*Pteris blechnoides* Willd.).
Tectaria Cav., 1802 (*Polypodium phymatodes*).

TEGULARIA Hornsch., 1825 = Didymochlaena.
TELEOZOMA R. Br., 1823 = Ceratopteris.
THELYPTERIS Adans., 1763 = Pteris.
Trichomanes L., 1753 (*T. crispum*).
PYXIDARIA Gled., 1764 (no type).
ACHOMANES Neck., 1790 (no type).
DIDYMOGLOSSUM Desv., 1827 (*Trichomanes muscoides*).
TRICHIPTERIS Presl, 1829 = Alsophila.
Todea Willd., 1802 (*Acrostichum barbatum*).
UGENA Cav., 1801 = Lygodium.
Vittaria J. E. Smith, 1793 (*Pteris lineata* L.).
VALLIFILIX Aud. de Petit Thouars, 1811 = Lygodium.
WIBELIA Bernh., 1801 = Hymenophyllum.
Woodsia R. Br., 1810* (*W. Ilvensis*).
PHYSEMATIUM Kaulf., 1829 (*P. molle*).
Woodwardia J. E. Smith, 1793 (*Acrostichum areolatum* L.).
Xiphopteris Kaulf., 1820! (*Grammitis serrulata*).

* The name usually quoted 1813 really dates from 1810 when it was proposed as *Woodia*.

MEMOIRS

OF THE

TORREY BOTANICAL CLUB

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Notes on Lichen Distribution in the Upper Mississippi Valley

By Bruce Fink

Under the above caption I shall discuss briefly certain features regarding past investigations of the distribution of lichens within the northern portion of a somewhat extended biological area, and make certain suggestions as to the amount and kind of work yet needed to an approximate completion of the study of these plants within the area treated. Since it has been the custom, in the region under consideration, for states to engage more or less extensively in botanical surveys, quite a number of papers have appeared, from time to time, dealing wholly or in part with lichen distribution within certain states or parts of states. Titles of these and other papers upon which this report is largely based are given in a bibliography of thirty-two titles.

Since a definite statement as to territory covered may be advantageous at the outset, I may state that I have confined myself to the following states: Missouri, Kansas, Nebraska, South Dakota, Minnesota, Wisconsin, Iowa, Illinois, Indiana, and Ohio. This list of states includes, so far as I have been able to ascertain through published bibliographies and correspondence with botanists, all the states in the upper valley in which any investigations of the lichen flora have been made and which do not extend into the mountainous regions to the east or west of the area selected. If any botanist can suggest to me any paper, bearing upon the subject, which I have overlooked, or any unpublished work which should receive consideration, he will confer a great favor and aid

in the study. Portions of states joining those named above on the west and east properly come within the territory as stated in my title, but the enumerations from those states are usually made in such a way that it is not possible to know in what portion of the states the plants were collected.

The work of collecting and classifying these plants in the area under consideration is, except in a few of the best studied localities, only well begun. Minnesota has furnished somewhat more than 350 lichens, and this number will be considerably increased as the survey of the state progresses. The whole area covered in this paper has thus far furnished only 527 lichens, or some 165 not found in the one state named above.

Considerable material collected in the various states is still undetermined, and some of it is the more difficult, containing many interesting species and some new ones. Indeed the numbers for the whole area can doubtless be doubled by more complete exploration. Although states seldom form natural biological areas, botanists residing in the various states will doubtless want to know the number of lichens recorded from each state. They are as follows: Minnesota, 348; Illinois, 248; Iowa, 226; Ohio, 180; Nebraska, 160; South Dakota, 76; Kansas, 47, Indiana, 30; Wisconsin, 29; Missouri, 9. Of those from Wisconsin, 21 are listed from a collection made by Professor L. H. Pammel, at La Crosse, and determined by me, remarkable for the number of interesting plants in so small a collection. The bibliographical reference of W. W. Calkins * to work by J. A. Lapham in Wisconsin was investigated and the conclusion was reached that the reference was incorrect; all the volumes of the series from which the citation is given were searched, and as yet nothing is found in print concerning Wisconsin lichens, except in Tuckerman's Synopsis. Other species added to published lists from the states are eight from Kansas, which I determined for E. Bartholomew and R. Dunlevy, and one of my own collecting in Illinois. These are indicated in the list by adding (P), (B), (D) and (F) respectively, after the name of the state.

The reports upon which this paper is based are in part preliminary, and the specimens collected, some of which I have not

* Calkins, W. W., 5 (number referring to bibliography published herewith).

seen, are deposited in various herbaria. As the determinations were made by various persons, doubtless some of the names of species listed are affected by the personal element in determination, and specimens named differently would in some instances almost certainly prove to be identical specifically could they be compared. However, the reports add much to our knowledge of the distribution of North American lichens as given by Tuckerman,* as much of the work in all of the states considered except Missouri, has been done since his death in 1886.

The papers referred to above have been too frequently mere lists, simply giving species and locality with no notes as to substrata or frequency of occurrence, and much less as to the causes which have led to the various peculiar features of distribution and habitat. So far as I know, the first paper to treat the subject of distribution in anything like a satisfactory manner was that by Mr. T. A. Williams† upon the lichens of the Black Hills. Since that time Professor C. Macmillan‡ has touched upon certain features, and the writer§ has attempted in several papers to consider lichen distribution in a somewhat adequate manner, presenting, to some extent, different phases of the subject in different papers as various localities and the progress of the work brought special problems into prominence.

Some of the interesting questions which may well claim the attention of lichen collectors in the future are as follows: Why are some regions richer in species and individuals than others? Why do certain areas produce a relatively large proportion of epiphytic, lithophytic, or epigeal lichens? Why are lichens commonly epiphytic, lithophytic or epigeal found on other substrata in certain localities? Where are, and what constitute the dividing lines between licheno-biological areas? What particular lichen-floral elements predominate in certain regions and why? Why do we find rapid changes in the lichen-flora in passing a certain distance or in a certain direction from one place and not in going the same distance from some other locality or in a different direction from the

* Tuckerman, E., 21 and 22.

† Williams, T. A., 28.

‡ Macmillan, C , 18.

§ Fink, B., 11, 12, 13, 14 and 15.

same place? To what extent can one predict as to what species will inhabit certain substrata in one region from knowledge of species found upon like substrata in other localities? To what extent do fruticulose and foliaceous lichens seek different substrata than those occupied by crustaceous species? What evidence does the present composition of a lichen-flora furnish concerning the former composition, the migrations which have taken place and their direction, and the struggle which has brought about the present floral composition?

In answering these questions, the various ecologic factors which influence the distribution of lichens must be kept in mind. Those which have especially attracted notice in my studies are the particular kinds of substrata in a region; changes in these substrata through the destruction of old and the introduction of new ones naturally, or through some animate and commonly human agency; climatic conditions of heat and moisture at present, and, in some instances, in the past as well; amount of illumination; the effects of bodies of water in bringing moisture; direction of prevailing winds influencing temperature; permanency and age of substrata and elevation of land. Other factors will present themselves to the careful observer. What I have outlined here is intended to be merely suggestive, and, for more detailed account, I must give reference to some 250 pages in the papers cited above from the three authors named. It is to be hoped that the important factors suggested above as influencing lichen distribution, and any others which may be brought out in actual work in the field in the future may be kept in mind by lichen collectors; and, if this brief paper shall in any degree aid in bringing about this result, the improvement in results in the lichenological field of work will be ample reward.

Notes regarding new or critical species might be added here, but I prefer to leave such work for future papers, adding here only a list of the 527 lichens hitherto found in the area under consideration and indicating the distribution by states. I have followed the arrangement, and, in general, the synonymy of Tuckerman, the latter of which is faulty in many instances, but which must serve till time is afforded for correcting it by careful research. Regarding the collections made by Dr. C. C. Parry and determined by the writer,* I have not been able to ascertain which were made in Wis-

* Fink, B., 8.

consin and which in Minnesota. Consequently, I have recorded but a single plant from this collection, the plant being otherwise unknown in either state. All of the others collected by him have been found since in Minnesota, and Wisconsin alone suffers in number of lichens by the uncertainty.

LIST OF SPECIES AND VARIETIES

Ramalina calicaris (L.) Fr.—Ia., Ill., O., Neb., Ind.
Ramalina calicaris fraxinea Fr.—Minn., Ia., Ill., Neb.
Ramalina calicaris fastigiata Fr.—Minn., Ia., Ill., O.
Ramalina calicaris canaliculata Fr.—Minn., Ia., O.
Ramalina calicaris farinacea Schaer.—Minn., Ia.
Ramalina polymorpha (Ach.) Tuck.—Minn.
Ramalina pusilla (Prev.) Tuck.—Minn.
Ramalina pusilla geniculata Tuck.—Minn.
Ramalina pollinarella Nyl.—Minn.
Ramalina pollinaria (Ach.) Tuck.—S. D., O.
Cetraria islandica (L.) Ach.—Minn.
Cetraria aleurites (Ach.) Th. Fr.—Ill., O.
Cetraria ciliaris (Ach.) Tuck.—Minn., Ia., Ill., O.
Cetraria lacunosa Ach.—Minn.
Cetraria aurescens Tuck.—Minn., O.
Cetraria juniperina pinastri Ach.—Minn.
Cetraria saepincola (Ehrh.) Ach.—Minn.
Evernia vulpina (L.) Ach.—Neb., Minn. or Wis.
Evernia furfuracea (L.) Mann.—Minn., D.
Evernia prunastri (L.) Ach.—Minn., Ia., O., Neb.
Usnea barbata (L.) Fr.—Ia., Ill., O., Ind., Neb., S. D.
Usnea barbata florida Fr.—Minn., Ia., Ill., O., Neb.
Usnea barbata strigosa Ach.—Ill.
Usnea barbata hirta Fr.—Minn., Ia., O., Neb.
Usnea barbata rubiginea Michx.—Minn., Ill., O.
Usnea barbata ceratina Schaer.—Minn., Ia.
Usnea barbata dasypoga Fr.—Minn.
Usnea barbata plicata Fr.—Minn., Ia.
Usnea angulata Ach.—Minn., Ia., O.
Usnea trichodea Ach.—Minn.
Usnea longissima Ach.—Minn.

Usnea cavernosa Tuck.—Minn., Ia.

Alectoria jubata (L.) Tuck.—Minn.

Alectoria jubata chalybeiformis Ach.—Minn., Ia., Ill.

Alectoria jubata implexa Fr.—Minn., S. D.

Speerschneidera euploca (Tuck.) Trev.—Kan.

Theloschistes chrysophthalmus (L.) Norm.—Minn., Ia., Ill., Neb., Kan., Wis. (P.).

Theloschistes parietinus (L.) Norm.—Ia., Ill., O., Neb., Wis., Kan. (B.).

Theloschistes polycarpus (Ehrh.) Tuck.—Minn., Ia., O., Neb., S. D.

Theloschistes lychneus (Nyl.) Tuck.—Minn., Ia., Ill., Neb., Kan. (B.).

Theloschistes concolor (Dicks.) Tuck.—Minn., Ia., O., Neb., Kan., Ind.

Theloschistes concolor effusa Tuck.—Minn., Ia., Neb., Kan.

Parmelia perlata (L.) Ach.—Minn., Ia., Ill., O.

Parmelia perlata olivetorum Ach.—Ill.

Parmelia perforata (Jacq.) Ach.—Minn., Ia., Ill., O., Neb., Wis., Ind.

Parmelia perforata hypotropa Nyl.—Minn.

Parmelia cetraria Ach.—Minn., Ia., Ill., O.

Parmelia laevigata (Sm.) Nyl.—Ill.

Parmelia aurulenta Tuck.—Ill.

Parmelia crinita Ach.—Minn., Ia., Ill., O., Neb.

Parmelia tiliacea (Hoffm.) Flk.—Minn., Ia., Ill., O., Neb., Ind.

Parmelia tiliacea sublaevigata Nyl.—Minn., Neb.

Parmelia tiliacea sulphurosa Tuck.—Ill., Neb.

Parmelia Borreri Turn.—Minn., Ia., Ill., O., Neb., Kan.

Parmelia Borreri hypomela Tuck.—Minn.

Parmelia Borreri rudecta Tuck.—Minn., Ia., Ill., Neb.

Parmelia saxatilis (L.) Fr.—Ia., Ill., O., Ind.

Parmelia saxatilis rosaeformis Ach.—Ill.

Parmelia saxatilis sulcata Nyl.—Minn., Ia., Ill., O.

Parmelia saxatilis panniformis Ach. Schaer.—Minn.

Parmelia physodes (L.) Ach.—Minn., Ill.

Parmelia encausta (Sm.) Nyl.—Minn.

Parmelia pertusa (Schrank.) Schaer.—O.

Parmelia colpodes (Ach.) Nyl.—Ill., O., Neb., Ind.
Parmelia olivacea (L.) Ach.—Minn., Ia., O., Neb., S. D.
Parmelia olivacea prolixa Ach.—Minn., Ill.
Parmelia olivacea aspidota Ach.—Ia., Ill.
Parmelia caperata (L.) Ach.—Minn., Ia., Ill., O., Neb., S. D., Ind.
Parmelia conspersa (Ehrh.) Ach.—Minn., Ia., Ill., Neb., S. D.
Parmelia molliuscula Ach.—Neb., S. D.
Parmelia centrifuga (L.) Ach.—Minn.
Physcia speciosa (Wulf., Ach.) Nyl.—Minn., Ia., O., Ill., Neb.
Physcia hypoleuca (Muhl.) Tuck.—Minn., Ia., Ill., O.
Physcia granulifera (Ach.) Tuck.—Minn., Ia., Ill.
Physcia comosa (Eschw.) Nyl.—Ia., O., Ill.
Physcia leucomela (L.) Michx.—O.
Physcia ciliaris (L.) DC.—Minn.
Physcia aquila (Ach.) Nyl.—Minn., Ia.
Physcia aquila detonsa Tuck.—Minn., Ill., O.
Physcia pulverulenta (Schreb.) Nyl.—Minn., Ia., Ill., O., Neb., S. D.
Physcia pulverulenta leucoleiptes Tuck.—Minn., O., Neb.
Physcia Leana Tuck.—O.
Physcia stellaris (L.) Tuck.—Minn., Ia., O., Ill., Neb., S. D., Kan., Ind., Wis. (P.).
Physcia stellaris apiola Nyl.—Minn., Ia., Ill.
Physcia astroidea (Fr.) Nyl.—O.
Physcia tribacia (Ach.) Tuck.—Minn., Ia., Ill., O.
Physcia hispida (Schreb., Fr.) Tuck.—Minn., Neb.
Physcia caesia (Hoffm.) Nyl.—Minn., Ia., Ill., O.
Physcia caesia stellata Fr.—Ill.
Physcia obscura (Ehrh.) Nyl.—Minn., Iowa, Ill., O., Neb., Kan.
Physcia adglutinata (Flk.) Nyl.—Minn., Ia., Ill., O., Neb., Wis., Kan.
Pyxine cocoes (Sw.) Nyl.—Ill.
Pyxine sorediata Fr.—Minn., Ia., Ill., O., Neb.
Umbilicaria rugifera Nyl.—Neb., S. D.
Umbilicaria cylindrica (L.) Delis.—S. D.
Umbilicaria Muhlenbergii (Ach.) Tuck.—Minn.

Umbilicaria Muhlenbergii alpina Tuck.—S. D.
Umbilicaria vellea (L.) Nyl.—Minn., S. D.
Umbilicaria Dillenii Tuck.—Minn., O.
Umbilicaria pustulata (L.) Hoffm.—Minn., O., Neb., S. D.
Umbilicaria hyperborea Hoffm.—Minn.
Sticta amplissima (Scop.) Mass.—Minn., O., S. D., Wis., Ind.
Sticta herbacea (Huds.) Ach.—Ill.
Sticta aurata (Sm.) Ach.—O., Neb.
Sticta pulmonaria (L.) Ach.—Minn., Ia., O., Wis., Ind.
Sticta quercizans (Michx.) Ach.—O.
Sticta limbata (Sm.) Ach.—Minn.
Sticta crocata (L.) Ach.—Minn.
Sticta scorbiculata (Scop.) Ach.—Minn.
Nephroma tomentosum (Hoffm.) Koerb.—Minn.
Nephroma helveticum Ach.—Minn., O., Ind.
Nephroma laevigatum Ach.—Minn., Ill., Ind.
Nephroma laevigatum parile Nyl.—Minn.
Peltigera venosa (L.) Hoffm.—Minn.
Peltigera aphthosa (L.) Hoffm.—Minn., O., S. D.
Peltigera horizontalis (L.) Hoffm.—Minn., Ia., O., Neb., S. D.
Peltigera polydactyla (Neck.) Hoffm.—Minn., Ia., Ill., O., Neb.
Peltigera scutata (Dicks.) Leight.—O.
Peltigera rufescens (Neck.) Hoffm.—Minn., Ia., Ill., O., S. D.
Peltigera pulverulenta (Tayl.) Nyl.—Ia., Wis., (P.).
Peltigera canina (L.) Hoffm.—Minn., Ia., Ill., O., Neb., S. D., Kan., Ind.
Peltigera canina spongiosa Tuck.—Minn., O., S. D.
Peltigera canina spuria Ach.—Minn., Ia., O., Neb.
Peltigera canina sorediata Schaer.—Minn., Ia.
Peltigera canina membranacea (Ach.) Nyl.—S. D.
Solorina saccata (L.) Ach.—Minn., S. D.
Heppia Despreauxii (Mont.) Tuck.—Minn., Ia., Ill., O., Neb.
Heppia polyspora Tuck.—Minn., Neb.
Pannaria languinosa (Ach.) Koerb.—Minn., Ia., Neb., Kan. (D.).
Pannaria rubiginosa (Thunb.) Delis.—O.
Pannaria microphylla (Sw.) Delis.—Minn., Ia., Ill., O.
Pannaria leucosticta Tuck.—Ill., O.

Pannaria crossophylla Tuck.—Ill., O.
Pannaria molybdaea cronia Nyl.—Ill.
Pannaria lepidiota Th. Fr.—Minn.
Pannaria flabellosa Tuck.—Minn.
Pannaria Petersii Tuck.—Ia.
Pannaria nigra (Huds.) Nyl.—Minn., Ia., Ill., Neb., S. D., Kan.
Pannaria nigra caesia Nyl.—Ia.
Pannaria byssina (Hoffm.) Tuck.—Ill.
Ephebe pubescens Fr.—Minn., Ill.
Ephebe solida Born. (?)—Minn.
Pyrenopsis Schaereri (Mass.) Nyl.—Ill.
Pyrenopsis phaeococca Tuck.—Minn., Ill.
Pyrenopsis melambola Tuck.—Minn.
Omphalaria Kansana Tuck.—Minn., Kan.
Omphalaria pulvinata Nyl.—Minn., Ia., Neb.
Omphalaria phyllisca (Wahl.) Tuck. (?)—Minn.
Omphalaria umbella Tuck.—Ia.
Collema pycnocarpum Nyl.—Minn., Ia., Ill., O., Neb., Kan.
Collema cyrtaspis Tuck.—Minn., Ill., O., Neb.
Collema laciniatum Ach.—Neb.
Collema microphyllum Ach.—Ill.
Collema verruciforme Nyl.—Ill.
Collema aggregatum Nyl.—Neb.
Collema flaccidum Ach.—Minn., Ia., Ill., O., Neb.
Collema leptaleum Tuck.—Ill., Neb.
Collema nigrescens (Huds.) Ach.—Minn., Ia., Ill., O., Neb.
Collema ryssoleum Tuck.—O.
Collema pulposum (Bernh.) Nyl.—Minn., Ia., Ill., O., Neb., S. D.
Collema tenax (Sw.) Ach.—Minn., Ia., Ill., O., Mo.
Collema crispum Borr.—Minn., Ia., O.
Collema limosum Ach.—Ill.
Collema plicatile Schaer.—Minn., Ia.
Collema furvum (Ach.) Nyl.—Minn., Ia.
Collema granosum (Wulf.) Schaer.—Ill.
Collema pustulatum Ach., Minn.—Ia., Ill.
Leptogium bolacinum Stizenb.—Ill.
Leptogium tenuissimum (Dicks.) Koerb.—Ill.

Leptogium caesiellum Tuck.—Ill.

Leptogium minutissimum (Flk., Schaer.).—Mass., Ill.

Leptogium lacerum (Sw.) Fr.—Minn., Ia., Ill., O., S. D.

Leptogium lacerum pulvinatum Moug. & Nestl.—Minn.

Leptogium pulchellum (Ach.) Nyl.—Minn., Ia., Ill., O., S. D.

Leptogium tremelloides (L.) Fr.—Minn., Ia., Ill., O.

Leptogium juniperinum Tuck.—Ill., O.

Leptogium dactylinum Tuck.—Ill., Neb., S. D., Mo.

Leptogium chloromelum (Sw.) Nyl.—Minn., Ia., Ill., O.

Leptogium myochroum (Ehrh., Schaer.) Tuck.—Minn., Ia., Ill., O.

Leptogium myochroum tomentosum Schaer.—Minn.

Leptogium myochroum saturnium Schaer.—Minn., Ill., O.

Placodium elegans (Link.) DC.—Minn., Ia., Neb., S. D., Wis. (P.).

Placodium murorum (Hoffm.) DC.—Minn., Ia.

Placodium murorum miniatum Tuck.—Minn.

Placodium cirrochroum (Ach.) Hepp.—S. D.

Placodium fulgens (Sw.) DC.—Neb., S. D.

Placodium fulgens bracteatum Ach.—Neb., S. D.

Placodium cinnabarrinum (Ach.) Anz.—Minn., Ia., Ill., O.

Placodium microphyllinum Tuck.—Minn., Ia., Ill., Neb., S. D., O.

Placodium citrinum (Hoffm.) Leight.—Minn., Ia., Neb., S. D., Kan.

Placodium aurantiacum (Light) Naeg. & Hepp.—Minn., Ia., Ill., O., Neb., Kan., Mo., Wis. (P.).

Placodium cerinum (Hedw.) Naeg. & Hepp.—Minn., Ia., Ill., O., Neb., Kan., Wis., (P.).

Placodium cerinum sideritis Tuck.—Minn., Ia., Ill.

Placodium cerinum pyracea Nyl.—Minn., Ia., Neb.

Placodium ferrugineum (Huds.) Hepp.—Minn., Ia., Ill., O., Kan., Wis. (P.).

Placodium ferrugineum Bolanderi Tuck., S. D.

Placodium ferrugineum Pollinii Tuck.—Minn., Ia., Ill., Neb.

Placodium vitellinum (Ehrh.) Naeg. & Hepp.—Minn., Ia., Ill., Neb., S. D., Wis. (P.), Kan. (D.).

Placodium vitellinum aurellum Ach.—Minn., Ia.

Placodium camptidium Tuck.—Ill., O.

Lecanora rubina (Vill.) Ach.—Minn., Ia., Neb., S. D.

Lecanora rubina opaca (Ach.) Fr.—Neb., S. D.
Lecanora rubina heteromorpha Ach.—Minn., Ia.
Lecanora Haydeni Tuck.—Neb., S. D.
Lecanora muralis (Schreb.) Schaer.—Minn., Ill., Neb., S. D., Kan. (D.).
Lecanora muralis versicolor Fr.—Minn., Ia., Neb.
Lecanora muralis saxicolor Schaer.—Minn., Ia., Neb., S. D.
Lecanora muralis Garovaglii Auz.—Neb.
Lecanora muralis diffracta Fr.—Minn.
Lecanora pallida (Schreb.) Schaer.—Minn., Ia., Ill., O., Ind.
Lecanora pallida cancriformis Tuck.—Ia.
Lecanora miculata Ach.—O.
Lecanora frustulosa (Dicks.) Mass.—Minn., S. D.
Lecanora sordida (Pers.) Th. Fr.—Minn., S. D.
Lecanora subfusca (L.) Ach.—Minn., Ia., Ill., O., Neb., S. D., Kan., Ind., Wis. (P.).
Lecanora subfusca discolor Fr.—Ill.
Lecanora subfusca allophana Ach.—Minn., Ia., Ill.
Lecanora subfusca hypnorum Schaer.—Minn.
Lecanora subfusca argentata Ach.—Minn., Ia., Ill., Neb.
Lecanora subfusca coilocarpa Ach.—Minn., Ia., Neb.
Lecanora subfusca distans Ach.—Minn., Ill., O., Neb.
Lecanora atra (Huds.) Ach. ?—Minn.
Lecanora Hageni Ach.—Minn., Ia., Ill., O., Neb., Kan., Mo.
Lecanora Hageni sambuci (Pers.) Tuck.—Minn., Ill.
Lecanora varia (Ehrh.) Nyl.—Minn., Ia., Ill., O.
Lecanora varia symmicta Ach.—Minn., Ia., Ill.
Lecanora varia saepincola Fr.—Minn., Ia., Neb.
Lecanora brunonis Tuck.—Neb.
Lecanora athrocarpa (Dub.) Nyl.—Ill.
Lecanora erysibe Nyl.—Minn., Ia., Ill.
Lecanora perproxima Nyl.—Ill.
Lecanora elatina Ach.—Minn.
Lecanora elatina ochrophaea Tuck.—Ill.
Lecanora punicea (Ach.) Tuck.—Ia.
Lecanora pallescens (L.) Schaer.—Minn., O.
Lecanora pallescens rosella Tuck.—O.
Lecanora tartarea L. Ach.—Minn., Ill., O., Ind.

Lecanora melanaspis (Wahl.) Ach.—Neb., S. D., Kan.

Lecanora cinerea (L.) Sommerf.—Minn., Ia., Ill., S. D.

Lecanora cinerea laevata Fr.—Minn.

Lecanora cinerea gibbosa Nyl.—Minn., Ia.

Lecanora calcarea (L.) Sommerf.—Minn., Ia., Ill., Neb., S. D., Kan.

Lecanora calcarea contorta Fr.—Minn., Ia., Ill., Kan., Wis., (P.).

Lecanora chlorophana (Wahl.) Ach.—Neb., S. D.

Lecanora xanthophana Nyl.—Minn., Ia., Neb., S. D., Kan., Mo.

Lecanora xanthophana dealbata Tuck.—Neb., S. D.

Lecanora Schleicheri (Ach.) Nyl.—Neb.

Lecanora cervina (Pers.) Nyl.—Minn., Ia., Ill., O.

Lecanora cervina pruinosa Ach.—Ill.

Lecanora glaucocarpa (Wahl.) Ach.—Neb., S. D., Kan.

Lecanora fuscata (Schrad.) Th. Fr.—Minn., Neb., S. D.

Lecanora fuscata rufescens Th. Fr.—Minn., Ia., Kan.

Lecanora Bockii (Fr.) Th. Fr.—Minn.

Lecanora privigna (Ach.) Nyl.—Minn., Ia., Ill., O., Neb.

Lecanora privigna pruinosa Auct.—Minn., Ia., Ill.

Lecanora privigna clavus Koerb.—Ia., Kan.

Rinodina oreina (Ach.) Mass.—Minn., Ia., Neb., S. D., Kan.

Rinodina mamillana Tuck.—S. D.

Rinodina ascociscana Tuck.—Minn., Ill.

Rinodina sophodes (Ach.) Nyl.—Minn., Ia., Ill., Neb., Kan.

Rinodina sophodes atrocinerea.—O.

Rinodina sophodes confragosa Nyl.—Minn., Ill.

Rinodina sophodes exigua Fr.—Minn., Ia., Neb.

Rinodina sophodes tephraspis Tuck.—Minn., Ia.

Rinodina Bischoffii (Hepp.) Koerb.—Minn., Ia., Ill., Kan.

Rinodina alboatra Fl.—Ill.

Rinodina lecanorina Mass.—Minn.

Rinodina constans (Nyl.) Tuck.—Ill.

Pertusaria velata (Turn.) Nyl.—Minn., Ia., Ill., O., Ind., Wis. (P.).

Pertusaria multipuncta (Turn.) Nyl.—Minn., Ia., Ill., O., Neb.

Pertusaria ambigens (Nyl.) Tuck.—Ia.

Pertusaria communis DC.—Minn., Ia., Ill., O., Neb., Mo., Kan., Ind.

Pertusaria pustulata (Ach.) Nyl.—Minn., Ia., Ill., O., Neb.

Pertusaria leioplaca (Ach.) Schaer.—Minn., Ia., Ill., O.

Pertusaria glomerata (Ach.) Schaer.—Minn.

Pertusaria globularis Ach.—Ill.

Pertusaria Wulfenii DC.—Ill.

Conotrema urceolatum (Ach.) Tuck.—Ia., Ill.

Gyalecta lutea (Dicks.) Tuck.—Minn., Ia., Neb.

Gyalecta fagicola (Hepp.) Tuck.—Minn.

Gyalecta pineti (Schrad.) Tuck.—Ill.

Gyalecta geoica trivialis Willey.—Ill.

Urceolaria scruposa (L.) Nyl.—Minn., Ia., Ill., Neb., S. D., Kan.

Urceolaria scruposa gypsacea Nyl.—S. D.

Urceolaria scruposa parasitica Sommerf.—S. D.

Urceolaria actinostoma Pers.—Minn., Ia., Kan.

Myriangium Duriaei (Mont. & Berk.) Tuck.—Ill., O.

Stereocaulon coralloides Fr.—Minn.

Stereocaulon paschale (L.) Fr.—Minn.

Stereocaulon condensatum Hoffm.—Minn.

Cladonia alcicornis (Lightf.) Flk.—Ill., S. D.

Cladonia symphycarpa Fr.—Minn., Ia., Ill., O., Neb., Ind.

Cladonia symphycarpa epiphylla (Ach.) Nyl.—Minn., Ia., O.

Cladonia mitrula Tuck.—Minn., Ia., Ill., O., Neb., Kan., Ind.

Cladonia cariosa (Ach.) Spreng.—Minn., Ia., Ill., O., Neb., S. D.

Cladonia decorticata Flk.—Minn.

Cladonia pyxidata (L.) Fr.—Minn., Ia., Ill., O., Neb., S. D., Kan., Ind.

Cladonia pyxidata pocillum Ach.—Ill., S. D.

Cladonia fimbriata (L.) Fr.—Minn., Ia., Ill., O., Neb., Ind.

Cladonia fimbriata tubaeformis Fr.—Minn., Ia., Ill., O., Neb., S. D.

Cladonia fimbriata radiata Fr.—Minn.

Cladonia degenerans Flk.—Minn., O.

Cladonia gracilis (L.) Nyl.—Minn., Ia., Ill., O.

Cladonia gracilis symphycarpia Tuck.—Minn.

Cladonia gracilis verticillata Fr.—Minn., Ia., Ill., O., S. D.
Cladonia gracilis cervicornis Fl.—Minn.
Cladonia gracilis hybrida Schaer.—Minn., Ia., O.
Cladonia gracilis elongata Fr.—Minn.
Cladonia comuta (L.) Fr.—Minn., O., Neb.
Cladonia delicata (Ehrh.) Fr.—Minn., Ia., O., Ind.
Cladonia turgida (Ehrh.) Hoffm.—Minn., Ill.
Cladonia turgida (Ehrh.) var. *conspicua* (Schaer.) Nyl.—Minn.
Cladonia cenotea (Ach.) Schaer.—Minn.
Cladonia papillaria molariformis Hoffm.—O.
Cladonia squamosa Hoffm.—Minn., Ia., Ill., O., Neb.
Cladonia squamosa phyllocoma Rabenh.—Minn.
Cladonia delicata (Ehrh.) Fl.—Minn., Ill., Ia.
Cladonia caespiticia (Pers.) Flk.—Minn., Ia., Ill., O., Ind.
Cladonia furcata (Huds.) Fr.—Minn., Ia., Ill., O., Neb., Kan., Ind.
Cladonia furcata crispata Flk.—Minn., Ill., O.
Cladonia furcata racemosa Flk.—Minn., Ia., Ill., O.
Cladonia furcata pungens Fr.—Minn.
Cladonia furcata subulata Flk.—Ill., O.
Cladonia rangiferina (L.) Hoffm.—Minn., Ia., O., Kan.
Cladonia rangiferina sylvatica L.—Minn., Ia., Ill., O.
Cladonia rangiferina alpestris L.—Minn., O.
Cladonia botrytis (Hag.) Hoffm.—Neb.
Cladonia amaurocraea (Flk.) Schaer.—Minn.
Cladonia uncialis (L.) Fr.—Minn., Ia.
Cladonia cornucopioides (L.) Fr.—Minn., Ia., O.
Cladonia deformis (L.) Hoffm.—Minn.
Cladonia digitata (L.) Hoffm.—Minn.
Cladonia macilenta (Ehrh.) Hoffm.—Minn., Ia., Ill., O., Neb., S. D., Wis.
Cladonia pulchella Schwein.—Ia., Neb.
Cladonia muscigena Eschw.—Ill.
Cladonia cristatella Tuck.—Minn., Ia., Ill., O.
Cladonia cristatella ramosa Tuck.—Ill., O.
Cladonia cristatella paludicola Tuck.—Minn.
Baeomyces byssoides (L.) Schaer.—Minn.
Baeomyces aeruginosus (Scop.) Nyl.—Minn.

Biatora decipiens (Ehrh.) Fr.—Minn., Ia., Neb., S. D., Kan., Mo.

Biatora decipiens dealbata Auct.—Minn., Ia.

Biatora Russellii Tuck.—Ia., O., Neb., S. D., Kan., Mo., Wis. (P.).

Biatora Russellii dealbata Tuck.—Ia.

Biatora icterica Mont.—Minn., Neb., Kan.

Biatora rufonigra Tuck.—Minn., Ill., Mo.

Biatora coarctata (Sm., Nyl.) Tuck.—Minn., Ill., S. D.

Biatora coarctata Brujeriana Schaer.—Minn.

Biatora granulosa (Ehrh.) Hoffm.—Ia., Neb.

Biatora flexuosa Fr.—Minn., Ill.

Biatora viridescens (Schrad.) Fr.—Minn.

Biatora parvifolia (Pers.) Tuck.—Ill.

Biatora vernalis (L.) Fr.—Minn.

Biatora peliaspis Tuck.—Ill.

Biatora russula (Ach.) Mont.—Ill., O., Neb.

Biatora sanguineoatra Fr.—Minn., Ill.

Biatora carnulenta Tuck.—Ia., Ill.

Biatora turgidula (Fr.) Nyl.—Minn., Neb.

Biatora leucophaea Flk.—Minn.

Biatora leucophaea griseoatra Koerb.—Minn.

Biatora uliginosa (Schrad.) Fr.—Minn., Ill.

Biatora myriocarpoides (Nyl.) Tuck.—Minn., Ia., Ill.

Biatora varians (Ach.) Tuck.—Minn., Ia., Ill., O., Neb.

Biatora flavidolivens Tuck.—Minn.

Biatora lucida (Ach.) Fr.—Minn.

Biatora atropurpurea (Mass.) Hepp.—Minn., Ill.

Biatora glauconigrans Tuck.—Minn.

Biatora Heerii Hepp.—Ill.

Biatora oxyspora (Tul.) Tuck.—Minn.

Biatora hypnophila (Turn.) Tuck.—Minn., Ia., Ill., Neb., S. D., Kan.

Biatora Naegelii Hepp.—Minn.

Biatora trachoma Flot.—Ia.

Biatora rubella (Ehrh.) Rab.—Minn., Ia., Ill., O., Neb.

Biatora fuscorubella (Hoffm.) Tuck.—Minn., Ia., Ill., O., Neb., Wis. (P.).

Biatora suffusa Fr.—Minn., Ia., Ill., O., Neb.
Biatora atrogrisea (Delis.) Hepp.—Ia., Kans. (B.).
Biatora Schweinitzii Fr.—Minn., Ia., O.
Biatora inundata Fr.—Minn., Ia., Ill., Neb.
Biatora incompta (Borr.) Hepp.—Minn., Ill.
Biatora effusa (Sm.) Hepp.—Ia.
Biatora stigmatella Tuck.—Neb.
Biatora muscorum (Sw.) Tuck.—Minn., Ia., Ill., Neb.
Biatora umbrina (Ach.) Tuck.—Minn., Ia., Ill., Neb.
Biatora chlorosticta Tuck.—Ill.
Biatora chlorantha Tuck.—Ill., O.
Biatora cyphalea Tuck.—Ill.
Biatora campestris Fr.—Ill.
Biatora geophana Nyl.—Ill.
Biatora fossarum (Duf.) Mont.—Ia., Ill.
Biatora resinae Fr.—Ill.
Heterothecium sanguinarium (L.) Flot.—Minn.
Heterothecium sanguinarium affine Tuck.—Minn.
Heterothecium grossum (Pers.) Tuck.—Neb.
Heterothecium leucoxanthum (Spreng.) Mass.—O.
Lecidea caeruleonigricans (Light.) Schaer.—O., Neb.
Lecidea granosa Tuck.—O.
Lecidea tessellina Fr.—Neb., Ill., Kan., Mo.
Lecidea tessellata Flk.—Neb., S. D.
Lecidea polycarpa Fr.—Neb.
Lecidea lactea Flk.—Minn.
Lecidea crustulata Ach.—Minn.
Lecidea lapicida Fr.—Minn.
Lecidea lapicida oxydata Fr.—Minn., S. D.
Lecidea contigua Fr.—Neb.
Lecidea speirea Nyl.—Minn.
Lecidea albocaerulescens (Wulf.) Schaer.—Minn., Ill., O., Ind.
Lecidea platycarpa Ach.—Minn., S. D.
Lecidea enteroleuca Fr.—Minn., Ia., Ill., O., Neb., S. D., Wis. (P.).
Lecidea enteroleuca achrista Sommerf.—Minn., Neb.
Lecidea enteroleuca theiloplaca Tuck.—Ia.
Lecidea melancheima Tuck.—Minn., Ia.

Lecidea crytidia Tuck.—Ill., Minn., Mo.
Lecidea acclinis Flot.—Minn., Ia., Neb.
Lecidea morio Schaer.—S. D.
Buellia epigaea (Pers.) Tuck.—Neb.
Buellia badia (Fr.) Koerb.—Kan.
Buellia spuria (Schaer.) Arn.—Minn., Ia., Ill., Kan., Mo.
Buellia alboatra (Hoffm.) Th. Fr.—Minn., Ia., Neb.
Buellia alboatra chlorospora Nyl.—Ill.
Buellia alboatra saxicola Fr.—Minn., Ia., S. D., Kan.
Buellia parasema (Ach.) Th. Fr.—Minn., Ia., Ill., O., S. D., Ind.
Buellia parasema triphragmia Nyl.—Minn., Ia., Neb.
Buellia dialyta (Nyl.) Tuck.—Minn.
Buellia myriocarpa (DC.) Mudd.—Minn., Ia., Neb.
Buellia myriocarpa polyspora Willey.—Minn., Ia., Ill., Wis., (P.).
Buellia pullata Tuck.—Minn., Ia.
Buellia turgescens (Nyl.) Tuck.—Minn.
Buellia Schaereri De Not.—Ill.
Buellia coarcina (Hoffm.) Th. Fr.—S. D.
Buellia colludens (Nyl.) Tuck.—O.
Buellia petraea (Flot.) Tuck.—Minn., O.
Buellia petraea Montagnaci Tuck.—Minn., S. D.
Buellia petraea grandis Flk.—Minn.
Buellia geographica (L.) Th. Fr.—Minn., S. D.
Buellia parmeliarum (Sommerf.) Tuck.—Minn., Neb.
Buellia pertusaricola Willey.—Neb.
Lecanactis premnea (Ach.) Tuck.—O.
Opegrapha demissa Tuck.—Ia.
Opegrapha atra (Pers.) Nyl.—Ill., O.
Opegrapha varia (Pers.) Fr.—Minn., Ia., Ill., O., Neb.
Opegrapha varia pulicaris (Hoffm.) Fr.—Minn., Ia., O., Neb.
Opegrapha varia notha Ach.—Minn.
Opegrapha vulgata (Ach.) Nyl.—Ill., O.
Opegrapha pulvinata Rehm.—Ia.
Opegrapha quaternella Nyl.—Ia.
Graphis scripta (L.) Ach.—Minn., Ia., Ill., O., Neb., Ind., Wis. (P.).

Graphis scripta serpentina Ach.—Ia.
Graphis scripta limitata Ach.—Minn., O., Neb.
Graphis scripta recta (Humb.) Nyl.—Minn.
Graphis eulectra Tuck.—Ia., Ill.
Graphis elegans (Sw.) Ach.—Minn.
Graphis dendritica Ach.—Minn., Ill., Neb.
Graphis substriatula Nyl.—Minn.
Arthonia pyrrhula Nyl.—Ill.
Arthonia lecideella Nyl.—Minn., Ia., Ill., O., Wis. (P.).
Arthonia pyrrhuliza Nyl.—Ill., O.
Arthonia dispersa (Schrad.) Nyl.—Minn., Ia., O., Neb., Kan. (B.).
Arthonia lapidicola Tayl.—Neb.
Arthonia radiata (Pers.) Th. Fr.—Minn., Ia., Ill., O., Neb.
Arthonia punctiformis Ach.—Minn., Ia., Ill., O., Neb.
Arthonia polymorpha Ach.—Ia., Ill., O.
Arthonia taediosa Nyl.—Ill., Neb.
Arthonia diffusa Nyl.—Ill.
Arthonia spectabilis Flk.—Ia., Ill., O., Ind.
Arthonia patellulata Nyl.—Minn., Ill.
Mycoporum pycnocarpum Nyl.—Ill., Neb.
Acolium tigillare (Ach.) De Not.—Minn., Ia., Ill., O.
Calicium trichiale Ach.—Minn.
Calicium trichiale stemoneum Nyl.—Minn.
Calicium brunneolum Ach.—Minn.
Calicium chrysocephalum (Turn.) Ach.—Minn., O.
Calicium chrysocephalum filare Ach.—Minn.
Calicium parietinum Ach.—Minn., Ia., Ill.
Calicium curtum Turn. & Borr.—Ill.
Calicium trachelinum Ach.—Ill.
Calicium roscidum trabinellum Nyl.—Ill.
Calicium quercinum Pers.—Minn., Ia.
Calicium hyprellum viride Nyl.—Minn.
Calicium microcephalum (Sm.) Turn. & Borr.—Ill.
Calicium byssaceum Fr.—O.
Calicium populineum De Brogn.(?)—Ill.
Calicium turbinatum Pers.—Minn., Ill.
Calicium tubiforme Mass.—Ill.

Sphinctrina tigillaris B. and Br.—Ia.

Coniocybe pallida (Pers.) Fr.—Minn., Ia., Ill.

Endocarpon miniatum (L.) Schaer.—Minn., Ia., Ill., O., Neb., Ind., Wis. (P.).

Endocarpon miniatum Manitense Tuck.—Ill.

Endocarpon miniatum complicatum Schaer.—Minn., Ia., Ill.

Endocarpon miniatum Muhlenbergii Ach.—Minn., Ia., Ill., O.

Endocarpon fluviatile DC.—Minn., O.

Endocarpon arboreum Schwein.—Minn., Ia., Ill., O.

Endocarpon cinereum Nees.—Ill.

Endocarpon hepaticum Ach.—Minn., Ia., Ill.

Endocarpon rufescens Ach.—Ill., Neb.

Endocarpon pusillum Hedw.—Minn., Ia., Ill., O., Neb., Wis (P..)

Endocarpon pusillum Garovaglii Kph.—Minn., Ia., Ill. (F.).

Thelocarpon prasinellum Nyl.—Minn., Ia.

Segestria Lauveri (Flk.) Tuck.—Ill.

Staurothele Drummondii Tuck.—Minn.

Staurothele umbrina (Wahl.) Tuck.—Minn., Ia., Neb., Wis. (P.).

Staurothele diffractella (Nyl.) Tuck—Minn., Ia., Ill.

Trypethelium virens Tuck.—O.

Sagedia oxyspora (Nyl.) Tuck.—Minn., Ill., O.

Sagedia castrensis Tuck.—Ill.

Sagedia lactea Kbr.—Ill.

Verrucaria epigaea (Pers.) Ach.—Minn., Ia., Ill.

Verrucaria nigrescens Pers.—Minn., Ia., Ill., O.

Verrucaria fuscella Fr.—Minn., Ia., Ill., Wis. (P.).

Verrucaria prospersella Nyl.—Ill.

Verrucaria rupestris Schrad.—Ia., Ill., O., Neb.

Verrucaria rupestris subalbicans Leight.—Neb.

Verrucaria muralis Ach.—Minn., Ia., Ill., O., Wis. (P.), Kan. (B.).

Verrucaria pyrenophora (Ach.) Nyl.—Ia., Ill.

Verrucaria viridula Ach.—Ill.

Pyrenula punctiformis (Ach.) Naeg.—Minn., Ia., Ill., Neb.

Pyrenula punctiformis fallax Nyl.—Minn.

Pyrenula glemmata (Ach.) Naeg.—Minn., Ia., Ill., O.

Pyrenula hyalospora (Nyl.) Tuck.—Minn., Ia.

Pyrenula nitida Ach.—Minn., Ia., Ill., O., Neb.

Pyrenula thaelena (Ach.) Tuck.—Minn., Ia., Ill., O.
Pyrenula cinerella (Flot.) Tuck.—Minn., Ia.
Pyrenula quinqueseptata (Nyl.) Tuck.—Minn.
Pyrenula leucoplaca (Wallr.) Kbr.—Minn., Ia., Ill.
Pyrenula subcinerea (Nyl.) Tuck.—Ill.
Pyrenula glabrata (Ach.) Mass.—Minn., Ia., Ill., O.
Pyrenula lactea (Mass.) Tuck.—Ia., Ill.
Pyrenula fallaciosa Stizenb.—Neb.

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MEMOIRS

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THE

HEPATICAE AND ANTHOCEROTES

OF

CALIFORNIA

BY

MARSHALL AVERY HOWE

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INTRODUCTION.

The aim of the subjoined work is to present a descriptive list of the Hepaticae and Anthocerotes of California, together with delineations of such species as have been hitherto either not at all or only quite imperfectly figured. Most of the material upon which the paper has been based was collected by the author during a residence of about five years in California. Of the Anthocerotes and the thalloid Hepaticae, specimens obtained in various stages of development were fixed with chromic acid and preserved in alcohol in order to retain better the natural outlines and also to permit a more accurate study of the internal structure through the use of microtome sections. Additional material has been contributed from time to time by friends and associates, among whom thanks are due especially to Miss Edith S. Byxbee, Dr. Willis L. Jepson, Professor L. M. Underwood, Professor Douglas H. Campbell, Professor A. J. McClatchie, Mr. S. B. Parish, Professor Edward L. Greene, Mr. M. S. Baker, Mr. F. P. Nutting, Mr. J. Burtt Davy, Mr. W. C. Blasdale, and Professor William A. Setchell. Specimens secured by the earlier collectors, notably the very important collections of Dr. Henry N. Bolander, have likewise been of great service. Through the kindness of the owners or custodians of various herbaria in Europe and America we have enjoyed the privilege of seeing, with two or three exceptions, the original materials of all the distinctively West American species which have been recorded as occurring within our limits.

It is possible that the first botanist to collect any Hepaticae in California was Archibald Menzies, who visited the region during the

last decade of the eighteenth century, though we are not in a position to affirm with certainty that he actually gathered any of these plants within the limits of what is now California, inasmuch as the only hepatic that we have seen, definitely known to be of Menzies' collecting (the original of *Porella navicularis*), is referred simply to the West Coast of North America, and the species is one that he may have found equally well, or better, farther to the northward. Dr. Thomas Coulter, about four decades later, seems to have been the discoverer of *Asterella violacea*, though it was a plant of Bolander's which, after the lapse of another forty years, served as the basis of Mr. Austin's diagnosis. Occasional Hepaticae were collected within the state from 1850 to 1880 by Dr. Albert Kellogg, Dr. J. M. Bigelow, Professor William H. Brewer, Professor John Torrey, Dr. C. C. Parry, and Dr. Edward Palmer. It was, however, Dr. Henry N. Bolander, who did much more than all the others to pave the way to a knowledge of the Californian hepatics. Dr. Bolander's services to Californian botany are too well known to need discussion here.* Suffice it to say that he was a resident of California from 1861 to 1878, and that while giving no more attention to cryptogamous plants than to the spermatophytes, his eye for mosses, liverworts, and lichens was astonishingly keen. He not only explored with much thoroughness the San Francisco Bay region, but as botanist of the State Geological Survey, and later as State Superintendent of Schools, was enabled to visit more remote portions of the state. Fully one half the species in the California hepatic list of today were known to him. Of these, at least twelve were new to hepaticology; seven now bear his name. The Hepaticae of Bolander's collecting were studied by Mr. Austin and by Dr. Gottsche. Professor W. G. Farlow visited the Pacific Coast in 1885 and collected a few plants of this group at various points in California. Professor L. M. Underwood also visited California in the summer of 1888 and made collections in Alameda, San Francisco, Marin, and Santa Cruz counties. Twelve specimens of Hepaticae were secured by Messrs. Coville and Funston on the Death Valley Expedition in the summer of 1891. In the summer of 1894, Mr. M. S. Baker and Mr. F. P. Nutting made a botanical journey through

* An interesting paper on "Dr. Henry N. Bolander, Botanical Explorer," by Dr. Willis L. Jepson, has appeared in Erythea, 6: 100-107. 1898.

portions of Shasta, Lassen, and Modoc counties, including in their collections several liverworts. Mr. Samuel B. Parish has found several species of Hepaticae and Anthocerotes in the San Bernardino Mts., and Professor A. J. McClatchie lists seventeen species in the "Flora of Pasadena and Vicinity."* Professor D. H. Campbell has made interesting discoveries in the neighborhood of Stanford University, two of which are the novelties *Sphaerocarpus cristatus* and *Riccia Campbelliana*, first described in the present paper. Mrs. Katharine Brandegee is thus far the only collector of Professor Campbell's new genus *Geothallus* and, so far as we know, is the only one to have found *Reboulia hemisphaerica* in California. Our own collections have been made in the region of the Bay of San Francisco, and in Sonoma, Mendocino, Humboldt, Trinity, Shasta, and Siskiyou counties. Although the hepatic flora of the coast counties may now be considered to be fairly well known, it is perhaps not too much to expect that explorations of the future will nearly double the number of species now known to occur in the state as a whole. That the present number—86, including one well-marked variety—is a very respectable one for the area involved may be readily seen by a comparison with the hepatic flora of the northern and eastern United States. In the sixth edition of Gray's Manual of the Botany of the Northern United States, 141 species are recognized by Professor Underwood under the Hepaticae. Subsequent additions and revisions leave the total about 150. When it is borne in mind that the area covered by the sixth edition of Gray's Manual is five times that of California, the 86 species now attributed to California make a fair showing in point of numbers as against the 150 of the northern and eastern states. But California has mountains of more than twice the height of any in the Gray's Manual region and in spite of the fact that the annual rainfall in many parts of the state is less than is requisite for the best development of bryophytic vegetation, the diversities of altitude, temperature, and humidity, afforded by the state as a whole, combine to give it a rich and varied hepatic flora, and one which in respect to the numbers of its species may be expected to compare favorably with any region of equal area in the United States. The whole great range of the Sierra Nevada is still almost a *terra*

* Reid, History of Pasadena, 624. 1895.

incognita so far as its bryology is concerned. The mountains of this range in order to yield the best results should be explored during the spring months, while the snows are leaving and while the ground is still moist. During the dry season, the terrestrial Hepaticae become shriveled and more or less covered with dust, and are usually difficult to detect. Several species known to occur in British Columbia, Washington, and Oregon are likely to be found also in northern California, especially, perhaps, near the well-watered coast. The more arid portions of the state will doubtless still yield Riccias and quite possibly new hepatic forms with special provisions for withstanding a season of drought, such as are exhibited by *Geothallus tuberosus* and *Anthoceros phymatodes*. Additions to the state list are to be expected from any quarter, but more particularly, we think, from the regions indicated.

On the following pages is a table designed to give some idea of the geographical range of the Hepaticae and Anthocerotes of California, taking into consideration only the hepaticologically better known portions of the Northern Hemisphere, the facts of distribution being compiled from the most recent and trustworthy sources. It will be seen that of our 86 species (representing 36 genera), 37 (43+%) occur also in the Gray's Manual Region (*i. e.*, the northern, eastern, and central United States, extending beyond the Mississippi River to the 100th meridian and southward to North Carolina and Tennessee); 40 (46½+%) in the British Isles; 46 (53½—%) in northern and central Europe; 46 (53½—%) in the Mediterranean Region of Europe; and 36 (42—%) in northern Asia (including Siberia, China, and Japan); 37 (43+%) are peculiar to Pacific Slope of America, several of them having not yet been found outside of California. It is of some interest to remark that the number of species peculiar to the Pacific Slope is proportionally greater than of those peculiar to the Gray's Manual Region, even though we may not stop to prove this by figures. The difference between 43% and 53½% is sufficient to justify the assertion that the hepatic flora of California has more in common with Europe than with the eastern and central United States. But facts involving the consideration of species do not always lend themselves with grace and accuracy to mathematical modes of expression. The European species *Porella laevigata*, *Riccia ciliata*, and *Anthoceros*

	California.	Eastern U. S. (Gray's Manual Region).	British Isles.	Northern and Central Europe.	Mediterranean Region.	Northern Asia (Siberia, China and Japan).
1.	*Riccia Lescuriana**	*	*	*	?	
2.	*trichocarpa*					
3.	*Californica*					
4.	*glauca*		*	*	*	*
5.	*minima*	*	*	*	*	*
6.	*Americana*					
7.	*Campbelliana*					
8.	*nigrella*	?		(France)	*	
9.	*Catalinae*					
10.	*crystallina*	*	?	*	*	*
11.	*Targionia hypophylla*		*	*	*	
12.	*Clevea hyalina*	? (Greenland)		*	*	
13.	*Clevea hyalina Californica*					
14.	*Reboulia hemisphaerica*	*	*	*	*	*
15.	*Grimaldia Californica*					
16.	*Cryptomitrium tenerum*					
17.	*Asterella Californica*					
18.	*Bolanderi*					
19.	*vio'acea*					
20.	*Palmeri*					
21.	*gracilis*	? (Greenland)		*	*	*
22.	*Conocephalum conicum*	*	*	*	*	*
23.	*Lunularia cruciata*	*	*	*	*	
24.	*Marchantia polymorpha*	*	*	*	*	*
25.	*Sphaerocarpus Californicus*					
26.	*cristatus*					
27.	*Geothallus tuberosus*					
28.	*Riccardia pinguis*	*	*	*	*	*

*We accept here the view of M. Heeg of Vienna (Bot. Not. 1898 : 111–116 1898) that the originally American *Riccia Lescuriana* occurs also in Europe. We have not been able, however, to make a critical comparison of the American and European forms.

	California.	Eastern U. S. (Gray's Manual Region).	British Isles.	Northern and Central Europe.	Mediterranean Region.	Northern Asia (Siberia, China and Japan).
62.	*Blepharostoma arachnoideum*					
63.	*Anthelia Juratzkana*		*	*	*	*
64.	*Ptilidium Californicum*					
65.	*Scapania Bolanderi*					?
66.	*nemorosa*	*	*	*	*	?
67.	*Oakesii*	*				
68.	*undulata*	*	*	*	*	*
69.	*umbrosa*	*	*	*	*	
70.	*curta*	?	*	*	*	*
71.	*heterophylla*					
72.	*Radula Bolanderi*					
73.	*comp anata*	*	*	*	*	*
74.	*Porella Bolanderi*					
75.	*rivularis*	*	*	*	*	
76.	*Roellii*					
77.	*navicularis*					
78.	*Frullania Catalinae*					
79.	*Bolanderi*					
80.	*Nisquallensis*					
81.	*Franciscana*					
82.	*Californica*					
83.	*Anthoceros phymatodes*					
84.	*Pear oni*					
85.	*Carolinianus occidentalis*					
86.	*fusiformis*					
	Totals	37	40	46	46	36

dichotomus are represented on the Californian coast by the close analogues, *Porella Roellii*, *Riccia trichocarpa* and *Anthoceros phymatodes*, their nearest relatives in the eastern United States being much farther removed; again, a species may be very common in Europe and very rare in California or, *vice versa*; and facts like these are wholly lost sight of in merely numerical comparisons of what we choose to regard as species. A few special considerations serve to emphasize the affinity of the California hepatic flora with that of Europe, particularly with that of the Mediterranean region. We have, to begin with, five species of the genus *Asterella* in California and the same number in Italy. In the eastern United States there is but one representative of this genus. Ten species of *Riccia* —a genus which seems to find its best development in southern Europe and northern Africa—are known to occur in California. Of these, one cannot be distinguished from a species otherwise known only in southern France and Italy, and one or two others are closely allied to species peculiar to the same regions. *Targionia hypophylla*, too, is another link in the chain that binds California to the warmer parts of Europe. This genus is absent in the eastern states, but what seems to be the very same species is found sparingly in the British Isles and central Europe, is more common in northern Italy, and is said to become very abundant in the southern portion of the peninsula. One rather common Californian hepatic seems to be identical with *Cephalozia Turneri*—one of the rarest of the Old World species, occurring in limited quantity at a few localities in the British Isles, France, the Canaries, Corsica and Algeria. No stations for this plant intermediate between California and the Old World are known, but it has been collected near San Diego and there is a probability that this species, like *Targionia hypophylla*, will be found to extend into Mexico. *Targionia* is represented in Mexico by two forms which were once considered distinct species but which have recently been reduced by Herr Stephani* to *T. hypophylla*. The presence of this peculiar genus *Targionia* in Mexico, the Canary Islands and Africa, and its absence, so far as is known, in eastern Asia suggest the possibility of some prehistoric land communication across what is now the Atlantic Ocean. The possibility of spores or entire plants finding their way across

* Bull. Herb. Boiss. 6: 764. 1898.

any extended portion of the sea and retaining their vitality seems very remote.

A departure from the customary classification is made in the treatment of the Anthocerotales. The commonly accepted arrangement recognizes two *classes*—the *Hepaticae* and the *Musci*—in the *phylum* or *subkingdom* BRYOPHYTA, though by some writers the *Sphagnaceae* are taken out from the *Musci* and made a separate class. Under the class *Hepaticae* are ordinarily recognized the three orders *Marchantiales*, *Jungermanniales*, and *Anthocerotales*. The last-named group differs from the Hepaticae proper in very important characters and we think these differences are best emphasized by raising the *Anthocerotales* to the rank of a class (under the name ANTHOCEROTES), coördinate with the Hepaticae, restricting this last term to the *Marchantiales* and *Jungermanniales*. This idea is not wholly a new one. Students of plant morphology, among whom Professor D. H. Campbell may be especially mentioned, have been approaching this view for several years, and this position was definitely taken by Mons. L. A. Gayet* in 1897 as a result of investigations on the archegonium alone, though the class was not named and defined by him in the normal systematic way. The peculiarities of the ANTHOCEROTES, briefly enumerated, are: (1) A single large chloroplast to each cell, instead of several smaller chloroplasts as in the assimilative tissues of the Hepaticae proper. Chlorophyll bodies like these—solitary in the cell—are known to occur elsewhere only in certain green algae and in certain tissues of *Selaginella*.† (2) The antheridia arise within the thallus—are endogenous in origin—and the walls of the immersed archegonia are confluent with the adjacent tissues. (3) The presence of meristematic tissue in the capsule near its base, by the activity of which the capsule has a long continued growth, ripening spores toward its apex while forming new spore-mother-cells below. (4) The presence, in probably all cases, of a columella around which the archesporium is formed. (5) The presence, in many cases, of stomata on the capsule, with accompanying assimilative tissue. These five characters are peculiar to the Anthocerotes as distinguished from the Hepaticae proper

* Ann. Sci. Nat. Bot. VIII. 3: 243, 244. 1897.

† Campbell, D. H. The Structure and Development of Mosses and Ferns, 115. 1895.

and they are characters of much significance. For analogies we must look chiefly in two directions—toward the Pteridophyta and toward the Musci.

The principal list of Californian Hepaticae and Anthocerotes hitherto published is that of Dr. Bolander, who included thirty species belonging to these two groups in his "Catalogue of the Plants Growing in the Vicinity of San Francisco."* Dr. Sereno Watson and Mr. Coe F. Austin prepared a manuscript descriptive of the Hepaticae and Anthocerotes of California for incorporation in the volumes devoted to botany in the Report of the Geological Survey of California, but for some reason it never saw the light. This manuscript, in which forty species are diagnosed, is now owned by Professor Underwood and has been accessible. At the end of the present paper will be found a list of the existing literature bearing directly upon the hepaticology of California and also a list of other hepaticological works which have been of the most service in the preparation of this paper.

With the hope of making the paper more useful to beginners in the study of the Pacific Coast Hepaticae, keys to the genera and species have been supplied. In the matter of synonymy and bibliography, no attempt is made to give anything beyond the most important references. Exsiccatae are cited only when Californian specimens are involved. In regard to nomenclature, the Rochester Code is applied in general, though perhaps not always rigidly and consistently; apparent exceptions are discussed under *Grimaldia*, *Lepidozia*, and *Asterella Californica*.

It has been our aim to distinguish as clearly as possible between statements based upon our own observations and those based upon the recorded observations of others, yet borrowings doubtless exist on the following pages, particularly in the diagnoses of genera, which are not expressly acknowledged to be such at the place of their occurrence. In framing definitions of genera, we have been assisted especially by the writings of Spruce, Schiffner, Lindberg, and Limpricht.

Whatever of value the present work may possess is largely due to the encouragement received from Professor L. M. Underwood, whose library, herbarium, and mature experience have been re-

* California Medical Gazette, May, 1870.

sources ever most generously placed at our command. In addition to the friends already mentioned, who have communicated Californian specimens, our thanks are due to numerous others who have kindly loaned types or sent specimens for comparison. We are especially indebted in this way to Mr. W. H. Pearson, Professor F. E. Weiss, Herr F. Stephani, Dr. B. L. Robinson, Dr. E. Levier, Dr. H. W. Arnell, Sir W. T. Thiselton-Dyer, Professor C. G. Limpricht, Dr. Harald Lindberg, Herr M. Heeg, Mr. Matthew B. Slater, Dr. Alexander W. Evans, Professor Romualdo Pirotta, Professor Günther Ritter von Beck, Mr. O. F. Cook and Mons. P. Hariot.

Class HEPATICAE.

Protonema very small, often rudimentary. Gametophore thallose or foliose or, in a few genera, of a character intermediate between these two types, mostly dorsiventral. Leaves, when present, composed of a single layer of cells, never with a true midvein, arranged upon the stem in two lateral ranks,* with sometimes a more or less well-developed ventral (third) rank. Root-hairs unicellular. Chloroplasts small, several or many in a cell in the assimilative parts. Antheridia and archegonia arising each from the subdivisions of a surface cell; archegonium individualized, its wall (except, rarely, the basal portion of the venter) always free from the adjacent tissues.

Sporogonium permanently enclosed within the modified archegonium wall (calyptra) or more frequently included until the capsule is nearly mature, when the calyptra is ruptured near the top by the growth of the capsule or by the elongation of the seta. Capsule without columella and without stomata, irregularly dehiscent, operculate, or more often opening by (usually) four valves. Spores ripening simultaneously, accompanied (except in *Ricciaceae*) by elongated, thin-walled sterile cells which (with rare exceptions) are provided with spiral thickenings (when each sterile cell is known as an elater).

Order I. MARCHANTIALES. †

Gametophore a thallus, consisting of several distinct layers of tissue, the usually clearly defined dorsal epidermis ‡ containing pores ("stomata" §) which communicate with narrow vertical

* Except in a very few genera, none of which are known to occur in California.

† For diagnosis of Order II, *Jungermanniales*, see page 62.

‡ *Dumortiera*, not yet found in California, has a very exceptional thallus, being without perceptibly differentiated epidermis, pores, or air-chambers.

§ The so-called "stomata" of the gametophore of the Marchantiales are quite different in structure from the stomata of the sporophyte in the *Anthocerotes*, *Musci*, *Pteridophyta*, and *Spermatophyta*, and are, perhaps, only in part analogous in function. But "stoma" as applied to the "breathing pore," together with its more or less modified epidermal surroundings, is a convenient term in the description of the Marchantiales and the use of the word in this extended sense is sanctioned by Lindberg, Schiffner, Stephani, and others.

canals or enlarged air-chambers in the subjacent chlorophyll-bearing layer and are often bounded by specialized epidermal cells. Ventral surface mostly provided with scales arranged in longitudinal rows. Root-hairs of two forms upon the same plant, the one with smooth walls, the other with interior peg-like papillae. Sexual organs aggregated in specialized parts of the thallus or on modified branches, or in the lower forms irregularly scattered.

The first four segments of the embryo sporogonium arranged like the quadrants of a sphere. Matured sporogonium consisting of a capsule without stalk or foot, all of the interior cells forming spores, or of capsule, foot, and short seta (rarely attaining length of 1–2 mm.), when some of the interior cells produce elaters.

The order Marchantiales comprises the two families *Ricciaceae* (see below) and *Marchantiaceae* (see page 34.)

Family I. RICCIACEAE.

Gametophyte a carnose, dichotomously branched or rarely subsimple thallus; chlorophyll-bearing tissues of suberect lamellae enclosing very narrow and inconspicuous subvertical air-canals or more ample chambers, these unoccupied by a specialized assimilative tissue. Stomata rudimentary, rarely well-developed. Ventral scales mostly present but sometimes obscure. Sexual organs arising singly from the dorsal surface just back of the growing apex, soon becoming deeply immersed in the thallus, the elongated archegonium-neck commonly exserted, the walls of the efferent canal of the antheridial cavity often produced into a conico-cylindrical elevation.

Sporophyte a capsule, without foot or seta, always enclosed by the calyptra, in which the spores come to lie at maturity through the disappearance of the delicate capsule-wall. Inner cells all producing spores.

1. RICCIA L. Sp. Pl. 1138. 1753. Ex Mich. Nov. Pl. Gen. 106. 1729.

Plants terrestrial, or rarely aquatic, often forming rosettes or half-rosettes, with linear, ovate, or cordate lobes, usually closely attached to the soil by root-hairs, the latter either smooth-walled or furnished with peg-like protuberances from the wall into the

lumen, thallus-segments commonly with a distinct median sulcus on dorsal surface; lamellae of the chlorophyll-bearing layer enclosing very narrow subvertical air-canals or less commonly larger chambers, the latter when present often breaking through to the surface, giving the thallus a spongy or lacunose appearance; ventral portions (costa) of the thallus composed of parenchymatous cells nearly or wholly destitute of chlorophyll; a rather poorly defined layer of somewhat prosenchymatous starch-bearing cells sometimes distinguishable between the chlorophyll-bearing and ventral strata; cells of the primarily superficial layer of the dorsal epidermis often soon collapsed and more or less disintegrated. Stomata represented by small pores surrounded by slightly or not at all modified epidermal cells. Scales hyaline-albescent, brownish-violet, or dark-purple, often fugacious,* rarely surpassing the margins of the thallus, originating in a single † median series, soon ruptured along the median line and becoming apparently two-ranked. Monoicous or dioicous. Sexual organs scattered, the antheridia irregularly intermingled with the archegonia in the monoicous species.‡ Involucre none. Capsules immersed. Spores large, for the most part distinctly tetrahedral, the surface marked with free or most frequently mesh-forming ridges, the angles of the areolae often with papilliform elevations, or the inner (plane) spore-faces sometimes simply punctate.

Key to the Species.

Thallus "solid," *i. e.*, with very narrow vertical or subvertical air-canals which communicate only inconspicuously with the dorsal surface.

Thallus furnished with scales underneath, not ciliate-margined.

Scales extending considerably beyond the margin, whitish-hyaline; spores immarginate, obscurely angular, 90–126 μ in maximum diameter.

6. *R. Americana.*

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* *R. crystallina* L. is said to have no traces of scales even as rudiments. They are scarcely distinguishable in some of the other Californian species.

† Herr Stephani, contrary to the usually accepted view, states (Bull. Herb. Boiss. 6: 311. 1898) that doubtless most *Ricciae* have an originally *double* series of scales. In all the Californian species which we have been able to subject to microtome sectioning, viz., *RR. Americana, nigrella, minima, trichocarpa, Californica,* and *Campbelliana,* the younger scales are clearly seen in a transverse section to extend uninterruptedly across the median line and to be attached to the body of the thallus on either side; later they become biseriate by a median longitudinal rupture.

‡ Professor Campbell has found in his researches on the development of the sexual organs in the Californian *Ricciae* that "several of one sort or the other would be formed in succession." We have sometimes had difficulty in finding anything but archegonia in species that could at other times be clearly shown to be monoicous.

Scales not reaching margin or rarely slightly exceeding it at thallus-apex.

Scales blackish-purple; thallus-segments 1–1.5 mm. wide; antheridial ostioles scarcely or not at all elevated. 8. *R. nigrella.*

Scales brown or nearly colorless, usually inconspicuous; thallus-segments 1–3 mm. (mostly 1.5–2 mm.) wide; antheridial ostioles prominent, conico-cylindrical. 7. *R. Campbelliana.*

Scales hardly distinguishable unless at thallus-apex, whitish or hyaline; thallus-segments mostly 1–2 mm. wide; ostioles elevated about .08 mm.; superficial epidermal cells soon becoming cup-like by disappearance of the upper portion of their wall; plane faces of the spores merely punctate or marked with numerous low mostly free ridges. 5. *R. minima.*

Thallus ciliate on margins or at apex.

Thallus-segments .75–1.5 mm. (mostly 1 mm.) wide, the margins densely ciliate; 1–12 cilia, with rare exceptions, springing from the dorsal epidermis above each capsule; spores soon black and very opaque, 90–120 μ in maximum diameter. 2. *R. trichocarpa.*

Thallus-segments 1–2 mm. wide, bearing few or numerous short cilia on margins toward apex but none on dorsal surface; antheridial ostioles not elevated; spores brown, 70–90 μ in maximum diameter, meshes of convex face 6–10 μ in width. 3. *R. Californica.*

Thallus-segments 2–2.5 mm. wide, the margins bearing a few short stout cilia; ostioles conico-cylindrical, .1–.2 mm. high; spores * 90–118 μ in maximum diameter. 1. *R. Lescuriana.*

Thallus naked on margins and underneath or with very rudimentary scales, very rarely with rudimentary cilia toward apex; antheridial ostioles conico-cylindrical; plane-faces of the spores reticulate-areolate, meshes of the convex face 10–15 μ in width. 4. *R. glauca.*

Thallus with large air-chambers which finally communicate conspicuously with the dorsal surface, giving thallus a spongiose or vesiculose-alveolate appearance.

Thallus light-green, rather loosely attached to the soil, very thin, the transverse sections at least six times broader than high; spores 90–108 μ in maximum diameter, with a margin 4–10 μ wide. 9. *R. Catalinae.*

Thallus often yellowish-green, very closely adherent to the soil, transverse sections of the segments 2.5–4 times broader than high; spores 60–90 μ in maximum diameter, with a narrow (sometimes almost deficient) margin 3–5 μ in width. 10. *R. crystallina.*

1. RICCIA LESCURIANA Aust. Proc. Acad. Nat. Sci. Philad. 1869: 232. 1869.

Thallus light green and reticulate above, concolorous below, or tinged with purple at margins, orbicular or semiorbicular in general outline; the principal divisions few, with a wide-angled (30° 90°) dichotomy 1–3 times repeated or subcruciately lobed, 6–10 mm. × 2–2.5 mm., mostly linear-obcuneate, the shorter sometimes nearly obcordate; terminal segments ovate-elliptical to

* See remarks on the size of the spores of the Californian *R. Lescuriana.*

oblong, subacute, with a few usually quite inconspicuous hyaline or whitish ventral scales at the apex, the flat-bottomed median sulcus occupying about one third their width but narrowed and apparently closed in front by the convergence of the abruptly ascending margins, these often incurved on drying, somewhat incrassate, though commonly subacute in cross-section, bearing in a single or double series a few stout obtuse or sharp-pointed cilia .1–.3 mm. long; transverse sections rounded ventrally, their width 2–3 times their height, about 20 cells thick in median parts, the air-chambers narrow; cells of the superficial layer of the epidermis soon collapsed and disintegrated or irregularly persisting as cups attached to the cells below: monoicous: antheridia abundant, their ostioles prominent, conic-cylindrical, .1–.2 mm. high: capsules with a naked, sometimes purple thallus-covering; spores brown, 75–118 μ in maximum diameter, angular, with a slightly granulate, more or less interrupted margin 3–12 μ in width, the outer face lightly papillate or nearly smooth in profile, 8 or 9 strongly defined areolae measuring its diameter, the inner faces a little less distinctly areolate or marked with ridges which scarcely anastomose.

On the bank of a rivulet, Fort Ross, Sonoma County, March 15, 1896.

The Californian plant differs from the typical *R. Lescuriana* chiefly in the larger spores (90–118 μ in the former; 75–100 μ in the latter) which are also more distinctly areolate on the inner faces. The thallus-margins and the thallus-covering of the capsules, too, show less purple than Mr. Austin's original plants from New Jersey, but these differences, we think, are not sufficiently important to be considered specific. Specimens collected at Jacksonville, Florida, by J. Donnell Smith in 1877, agree essentially with the Fort Ross plant. *Riccia Lescuriana* is perhaps more likely to be confused with *R. Californica* than with any of the other Californian *Ricciae*, from which, however, it may be easily distinguished by the larger spores, the prominent antheridial ostioles, the shorter, stouter cilia, etc.

We would place, for the present, with the above species a somewhat anomalous *Riccia* collected in California by Bolander (in herb. Underwood, from U. S. National Museum). The thallus is but once forked and unusually thin, the transverse sections being 4–6 times as wide as high; the cilia are rudimentary or wanting; the spores have more numerous and smaller areolae, 10–12

measuring the diameter of the convex face. Its large spores (90–105 μ), the broad divergent thallus-lobes and other minor characters stand in the way of its reference to *R. glauca*.

2. RICCIA TRICHOCARPA M. A. Howe, Bull. Torr. Bot. Club, **25**: 184. *pl. 337*. 1898.

Thallus in rosettes about 2 cm. in diameter or forming somewhat irregularly radiating masses; the principal divisions linear, 2–6 times dichotomous, .75–1.5 (mostly 1) mm. in width, often black below and at margins, densely clothed at the sides with white or tawny setae .3–.65 mm. long, those toward the apices often in as many as 8–12 irregular series, mostly distinct at insertion, with sharp, rigid, rarely slightly uncinate points, the terminal thallus-lobes obcuneate or oblong-elliptical, obtuse or subacute, narrowly and rather deeply unicanaliculate toward the apices or subbicanaliculate, the furrow at the extremities commonly concealed by the trichomes, the median sulcus sometimes nearly vanishing toward the base, margins obtusely rounded, tumid, often connivent on drying, the furrow then thatched by the somewhat forwardly directed setae; dorsal surface light green, minutely and regularly reticulate; ventral surface nearly plane and flat, with a few very inconspicuous scales on either side of the median line at the apices, falsely squamose in the basal parts through delamination due to marcescence; width of transverse sections 1.6–3 times their height, the posterior subquadrangular with a light median sulcus, the margins becoming more tumid and rounded in proceeding toward the apex and the sulcus now and then double, the sections convex ventrally only in the extreme apical region; 20–28 cells in thickness in median parts, texture nearly solid, the air-chambers narrow and vertical; epidermis primarily bistratose, the superficial layer at first papillate, afterwards collapsed, and in the older parts reduced to a flattened cellulose membrane incumbent on the lower layer: monoicous: antheridia scattered, the ostioles elevated about .1 mm.: sporogonia numerous, in a single or double series, immersed, finally—especially when dry—hemispherical-protuberant above, together with the long-unruptured covering, or subconical, the covering marked with a dark-purple spot and bearing with rare exceptions 1–12 setae; spores soon black and very opaque, narrowly or not at all margined, 90–120μ in maximum diameter, minutely granulose-papillate, with 9–12 areolae (visible only in the younger spores) across the convex face, the walls of these with irregularly thickened and salient angles, thus often giving this face in profile the appearance of bearing columnar or wart-like elevations, areolae across one of the plane faces 5–7 in number, scarcely elevated at the angles.

EXSICC. Hep. Bor.-Am. 143[b] (as *R. tumida* Lindenb.).
Hep. Am. 138* (as *R. arvensis* Aust., var. *hirta* Aust.).

On rather dry and rocky soil. About San Francisco, "Mission Dolores," "Turk St.," "near Ocean House" (Dr. Bolander), Mission Dolores (Howe); Berkeley (Howe); Ukiah (Howe); near Stanford University† (Prof. D. H. Campbell, Palo Alto (S. E. Brown); Santa Ana Hills (Parish); Pasadena (McClatchie); San Diego (Mrs. Katharine Brandegee).

The above is the Californian *Riccia* that has been referred variously by American authors to *Riccia ciliata* Hoffm., *R. tumida* Lindenb., *R. intumescens* Aust. MS., Underw. (*R. ciliata* Hoffm., var. *intumescens* Bisch.) and more recently to *Riccia hirta* Aust. (*R. arvensis* Aust., var. *hirta* Aust.). But *Riccia arvensis hirta** known only from Mr. Austin's specimens from the neighborhood of Closter, New Jersey, bears comparatively few, short, usually blunt-pointed and incurved papilla-like cilia .1–.3 mm. long (not *setae*), the thallus is strongly incrassate-carinate ventrally, the margins are acute, the epidermis is very thick, of 2 or 3 layers of decolorate or purple-tinged cells, the somewhat smaller, more distinctly margined spores are fuscous-brown at maturity and always show their areolae quite clearly in glycerine instead of being densely black and opaque as in *R. trichocarpa* under the same treatment, the plants are mainly smaller and less frequently dichotomous, the thallus-segments are usually comparatively broader, reddish-purple below and more evidently squamigerous.

A much nearer ally of *Riccia trichocarpa* is doubtless *R. ciliata* Hoffm. of Europe. From the typical form of this, however, the Californian plant is clearly distinct in the shorter and much more abundant setae (these often reach 1 mm. in length in *R. ciliata*), in the presence of trichomes over the sporogonia, in the rather larger size of the thallus, more acute-angled dichotomy, and in the commonly black margins and sides. From *R. ciliata intumescens*

* See footnote, Bull. Torr. Bot. Club, **25**: 186. 1898.

† Professor Campbell's specimens, which we took as the type of this species, were distributed in the Hep. Am., by error, as having been collected in San Mateo Co., and this locality was copied in connection with our original description. We are informed, however, by Prof. Campbell, that the specimens came from Santa Clara Co., near the San Mateo Co. line.

Bisch, known to us only from the excellent figures and description of its author and from a specimen communicated by Herr M. Heeg, our plant differs in the longer, narrower segments, in the shorter and even more crowded lateral setae, those toward the apex often in as many as 8–12 irregular series, and in the normal presence of 1–12 long trichomes above each sporogonium, while in *R. ciliata intumescens*, the "cilia" appear to be of somewhat rare occurrence on the dorsal surface. In *R. ciliata*, the tissues covering the mature sporogonium soon become thin, scarious, and shining, and finally break away in fragments, exposing the capsule and the spores, and Bischoff* remarks of the capsules of the var. *intumescens*: "*post maturitatem rupti, foveolas sporis repletas in frondis pagina superiore relinquentes*"; while in *R. trichocarpa* the covering of the capsules remains very long intact—indeed, in only one case out of several specimens with spores evidently much past maturity, have we seen the contents of a capsule exposed by natural agencies.

Riccia crinita Tayl. from Swan River, Australia (Drummond, no. 42), the original of which we have seen through the kindness of Dr. B. L. Robinson, is close to *R. trichocarpa* in character and number of setae, which also sometimes occur over the sporogonia. But *R. crinita* is a smaller plant, only 2 or 3 times dichotomous, with shorter, oblong rather than linear segments, the thallus is comparatively much thinner, the vertical sections of its segments being 3–7 times as wide as high, the margins are acute and commonly incurved; the spores (possibly not arrived at full depth of color) are light-brown, .75–90 μ in maximum diameter, with 11–14 smaller areolae across the convex face, this scarcely papillate in profile, the plane faces similarly areolate, the mesh-forming ridges throughout and the narrow margin nearly smooth.

Riccia Michelii Raddi, var. *ciliaris* Levier (=*R. tumida* Lindenb. and *R. palmata* Lindenb. *fide* Levier) differs so widely from our species that a detailed comparison is unnecessary.

R. trichocarpa may be found with archegonia and antheridia in January and early February, ripening its capsules in April and May. Like all the Californian *Ricciae* it is practically invisible during the summer months.

* Acta Acad. Caes. Leop.-Carol. Nat. Cur. 17: 1063. 1835.

PLATE 88. RICCIA TRICHOCARPA.

1 and 2. Portions of the plant, natural size.

3. Terminal segments of a young thallus, dorsal view, × 5.

4. End of thallus lobe from fig. 1, with ostioles and a sporogonium, × 10.

5. Lateral view toward apex of a thallus-segment, showing the numerous trichomes, × 20.

6. Marginal trichomes, × 53.

7. Portions of thallus exhibiting the trichome-bearing elevations above the capsules, × 20.

8–13. Outlines of transverse sections about 10 μ in thickness at selected points from near the apex to the old and shriveled base, × 23. The trichomes do not appear so abundant as might be expected from the material used for microtome sectioning, which may be explained from the thinness of the sections and by the fact that the detached sections and fragments of the trichomes have not always adhered to the glass slides. Fig. 8 shows small median scales.

14. Epidermis and subjacent cells from a younger portion of the thallus, × 225. The superficial layer is here represented as composed of collapsed cells. In the extreme apical region only they are papilliform.

15. Epidermis in older parts of the thallus, × 225. The collapse and disintegration of the cells of the outer layer is so complete that only a structureless cellulose film remains.

16. Cross-section of thallus showing the cell structure and a young sporogonium, × 53.

17. Spores, × 305.

Figs. 1, 2, 4–7 and 17 from Hep. Am. no. 138 collected near Stanford University, April, 1892, by Prof. D. H. Campbell; figs. 3 and 8–16 from material fixed with 1 percent. chromic acid and preserved in alcohol, collected by the author near Berkeley, California, February 8, 1896.

3. RICCIA CALIFORNICA Aust. Bull. Torr. Bot. Club, 6:46. 1875.

Thallus forming light green, somewhat glaucescent rosettes 8–18 mm. in diameter, concolorous beneath, reticulate above, often minutely puberulent or scurfy when moistened; the principal divisions 1–3 times dichotomous; terminal segments short-oblong or obovate, 1–2 mm. wide, bearing toward the subtruncate or retuse apex few or numerous whitish or subfuscous, mostly slender and sharp-pointed cilia .16–.4 mm. in length, the commonly obtuse margins elevated and somewhat tumid when young, the median sulcus broad and obtuse except at the extreme apex, vanishing backward, the segments more or less concave dorsally on drying, rarely nearly plane, scales very rudimentary (none in the ordinary sense); width of transverse sections 2–5 times their height, thickness of thallus 15–25 cells in median parts, the upper layers of cells chlorophyllose, the lower often nearly or quite destitute of contents, air-chambers narrow and vertical; cells of the superficial layer of the epidermis hemispherical-convex or papilliform near the growing apex of the thallus, soon collapsed or disintegrated, per-

sisting only as imperfect and irregular cups or more often as mere wall-fragments adhering to the hyaline and nearly empty cells of the primitively lower layer: monoicous: antheridia infrequent, the ostioles not elevated above the surface of the thallus: archegonium-neck exserted and often conspicuous even at maturity of the sporogonium: capsules deeply immersed, with a naked long unruptured covering, in rare cases exploded-protuberant with age; spores brown, finally darkening but always more or less translucent, 70–90 μ in maximum diameter, distinctly angular, with a smooth yellow or brownish irregularly crenate margin 3–12 μ in width, the diameter of the outer face measured by 10–13 areolae, these mostly 6–10 μ in width, the papilliform elevations at the angles of the meshes 3–4 μ or less in height when seen in profile, the inner faces with similar but less papilliform-angled areolae.

On lightly shaded banks. "California" (Dr. Bolander; the original specimens in Herb. Pearson). Berkeley (Howe), Fruit Vale (Miss Edith S. Byxbee); Clarendon Heights, San Francisco (530*), and near the Mission Dolores (512); Ukiah, Mendocino Co. (783); Silver Lake, Alpine Co. (Geo. Hansen).

The cilia in this species are occasionally reduced and inconspicuous, but are always present, we believe, even though sometimes only in a rudimentary form.

Riccia subinermis Lindb. (1881), of which we have been allowed to see authentic specimens through the kindness of Mr. Harald Lindberg and specimens of which we also owe to Herr M. Heeg, differs from *R. Californica* in the usually much shorter and less numerous cilia, in the elevated conico-cylindrical antheridial ostioles, in the larger meshes of the outer face of the spores, in the less regular areolation of the inner faces, etc. The areolae of the outer face in *R. subinermis* and *R. glauca* are mostly 10–15 μ in width, while in *R. Californica* they are usually only 6–10 μ wide. We agree with Dr. Levier and others in thinking *Riccia subinermis* doubtfully distinct from *R. glauca*.

PLATE 89. RICCIA CALIFORNICA.

1. The plant, natural size, from a dried specimen.
2. Two of the principal segments of the thallus, from alcoholic material, × 5.
3. A portion of Austin's original plant (soaked out), *ex herb.* Pearson, × 5.
4–8. Outlines of transverse sections of a principal segment at somewhat regular intervals, passing from near apex toward the base, × 23.

* The numbers refer to specimens collected by the author.

9. Transverse section near the middle of a principal segment of another plant, × 23.

10. From same segment as fig. 9, but near the base, × 23.

11. Epidermal cells from near the thallus-apex, × 225.

12. Epidermis from an older part of the thallus, showing remnants of the primitive surface-layer, × 225.

13. Marginal trichomes, × 53.

14. Transverse section of thallus, × 53.

15. Spore, showing the inner (plane) faces, × 305.

16. Spore, showing the outer (convex) face, × 305.

Figs. 1, 2, 9, 10 and 12 from no. 530, Clarendon Heights, San Francisco; fig. 3, from Mr. Austin's original, *ex herb.* Pearson; figs. 11, 13, 14–16 from material collected at Fruit Vale, by Miss Edith S. Byxbee; figs. 2 and 4–14 from material fixed with 1% chromic acid and preserved in alcohol.

4. RICCIA GLAUCA L. *pro parte maxima* Sp. Pl. 1139. 1753.

Differs from *R. Californica* chiefly in the normal absence of cilia, the presence of cylindrical or conico-cylindrical antheridial ostioles projecting about .1 mm. above the surface of the thallus, and in having the meshes of the outer face of the spore 10–15 μ in width.

Little Bear Valley, San Bernardino Mts. (S. B. Parish, no. 1670, Aug. 1884, in herb. Underwood); near Mineral King, Tulare Co. (Coville and Funston, Death Valley Expedition, no. 1509, Aug. 6, 1891).

Mr. Parish's plant differs from the larger forms of the European *R. glauca* in nothing, we think, but the rather smaller meshes of the convex face of the spore, which, in this specimen, are commonly only about 10 μ in width. The specimen from Tulare Co., while exhibiting the ostioles of *R. glauca*, has now and then rudimentary cilia toward the thallus-apex and would doubtless be identified with the *Riccia subinermis* Lindb. of Europe by those who maintain this as a species.

It may be remarked that according to the drawings of Herr Waldner* one might gain the impression that the ostioles of *Riccia glauca* are scarcely elevated above the general surface of the thallus, but it is probable that the antheridium in even the most advanced stages represented by Waldner was still far from maturity. The "Antheridienstifte" of *R. glauca* are described by Limpricht† as "walzenförmig vortretend" and we find them thus (.1 mm. long) in G. & R. Hep. Eur. no. 646.

* Leitgeb, Untersuch. über d. Leberm. Heft 4. *pl. 2. f. 4–6.*

† Cohn, Krypt.-Fl. v. Schles. 1: 349. 1877.

5. RICCIA MINIMA L. *p. p.* Sp. Pl. 1139. 1753.

Riccia sorocarpa Bisch. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **17**: 1053. 1835.

Thallus at first subradiate, forming later irregularly gregarious patches, of a bright, clear, subcrystalline light green (not puberulent or scurfy) when living or when soaked out with water, of a lighter green when dry, minutely, regularly, and compactly reticulate above when moistened, sometimes nearly smooth on drying, concolorous below; the principal divisions 4–7 mm. long, bifid or once or twice dichotomous; the terminal segments oblong, .75–2 mm. wide, subacute, carinate-incrassate, with an acute median furrow and naked, ascending, for the most part sharply acute, often hyaline and submembranous margins, furnished beneath toward the apex with small whitish or hyaline scales, these often reaching the margin but not surpassing it, the margins commonly elevated or somewhat incurved on drying; transverse section parabolic or subquadrate, its width 1–4 times its height, about 25 cells thick in median parts, air-chambers narrow; epidermis of two or three layers of cells, those of the superficial stratum at first papilliform, the lower portion of their wall becoming thickened and the upper soon vanishing, leaving behind persistent cups attached to the likewise thick-walled cells of the subjacent layer: monoicous: antheridia few, the ostioles short-cylindrical, elevated about .08 mm.; capsules usually numerous, with age sometimes emergent-protuberant toward the base of the segments by rupture of the naked covering; spores dark brown, 70–90 μ in maximum diameter, angular, with a brownish granulate-papillate and crenulate, usually interrupted margin 3–6 μ broad, the outer face areolate, 10–12 meshes measuring its diameter, exhibiting in profile papillae mostly 3–6 μ long, the inner faces densely and rather minutely punctate or furnished with very short and numerous low ridges which do not form areolae.

Exsicc. Hep. Am. 139 (as *R. glauca*).

Not uncommon in the coast region, often associated with *R. Californica*.

Berkeley, Oakland, Fruit Vale; Clarendon Heights and near Mission Dolores, San Francisco; Fort Ross, Sonoma Co.; Ukiah (782); Mitchell Cañon, Mt. Diablo; near Stanford University (D. H. Campbell); Pasadena (A. J. McClatchie).

The Californian plant is usually larger than the European specimens that we have seen, yet it very rarely attains the dimensions of representatives of this species collected in Siberia by Dr. H. W.

Arnell, to which Herr M. Heeg refers in the Botaniska Notiser for 1898 (p. 21) and which we have been privileged to examine through the courtesy of Dr. Arnell. The antheridial ostioles in the European plant so far as we have been able to discover them in specimens kindly communicated by Herr Stephani, Herr Heeg, and others, seem to be very slightly or not at all elevated, yet in the Siberian specimens to which allusion has already been made they sometimes attain the height of .12 mm. above the surrounding surface, which is in excess of anything we have observed in the Californian specimens.

In only one case have we noticed the partial exsertion of the sporangium at maturity as figured and emphasized by Bischoff in his original diagnosis of *R. sorocarpa*. In regard to this character Herr Heeg remarks: "die von Bischoff besonders hervorgehobene Berstung der Lauboberfläche bei der Fruchtreife, bezeichnet das Endstadium einer Entwicklungsperiode und wird nur selten gerade in diesem Zustande aufgesammelt." *

6. **Riccia Americana** sp. nov.

Riccia lamellosa Americana M. A. Howe, *p. p.* Bull. Torr. Bot. Club, **25**: 189. 1898.

Thallus rather loosely subradiate or forming compact more or less imbricate masses; principal divisions 5–15 mm. long, 1–3 times dichotomous, very rarely simple, 2.5–4 mm. in greatest width, pale green and regularly reticulate above, concolorous below, acutely and deeply canaliculate toward the apex, 25–30 cells thick in median parts, furnished beneath with large obtuse transverse patent or somewhat imbricate subundulate hyaline scales, these extending considerably beyond the acute or thin-membranous ascending or, when dry, often erect-connivent margins; the transverse sections 1.5–3 times as broad as high; the terminal segments emarginate, oblong to obcordate, mostly obovate; epidermis of two layers of cells, the superficial at first subglobose or oval-papilliform, later collapsed or disintegrated, two or three of the subjacent strata sometimes becoming decolorate: monoicous (polyoicous?): antheridia infrequent, their ostioles not at all or slightly elevated: spores brown, 90–126 μ in maximum diameter, obscurely angular, wholly destitute of a wing-margin, with 8–12 clearly defined areolae, each about 15 μ in width, across the outer face, the inner faces marked with much smaller and much less distinct areolae or simply with irregular vermicular lines.

* Heeg, Bot. Notis. **1898**: 20. 1898.

On exposed or lightly shaded banks, often associated with *R. nigrella*, *R. trichocarpa* and *R. Californica*. San Francisco (Bolander), on hillsides between Mission Dolores and Clarendon Heights, San Francisco (Howe); Fruit Vale (Miss Edith S. Byxbee, Howe).

Riccia Americana is closely related to *R. lamellosa* Raddi, from which, however, it differs very markedly in spore-characters. The European plant has distinctly wing-margined and plainly angular spores and the markings of the inner and outer faces are nearly uniform; the ridges of the outer face are more vermicular than in *R. Americana* and less often form perfect areolae, and when the areolae are well defined, they are smaller and more numerous, 14 or 15 measuring the diameter of the face. The scales in *R. Americana* are more prominent than in *R. lamellosa*. For comparison, we have made use of a specimen from Florence, Italy (the type locality), and one from Sicily, both kindly communicated by Dr. E. Levier.

Riccia Austini Steph. (Bull. Herb. Boiss. **6**: 336. 1898) is a nearer ally in respect to spore-characters, with the exception that the spores are smaller (75–105μ in maximum diameter), but differs in the much thinner and mostly smaller thallus, this being only 14–20 cells in greatest thickness and the breadth of the transverse sections being 3–4 times their height, and in the less conspicuous scales. *R. Americana* seems to occupy a somewhat intermediate position between these two species. In case it should ever be combined with *R. Austini*, this latter name should be employed for the aggregate, inasmuch as it was published, we are informed by Dr. Eugène Autran, editor of the *Bulletin de L'Herbier Boissier*, about two weeks in advance of our *Riccia lamellosa Americana*.

We have been able to see only four or five antheridia in this species though hundreds of sections have been made. In two instances, archegonia occurred on the plants bearing the antheridia; and in two other cases no archegonia were to be discovered, but in the latter cases we were sectioning somewhat fragmentary alcoholic material. The great majority of the plants examined showed archegonia without traces of antheridia.

PLATE 90. RICCIA AMERICANA.

1. Dry plant, natural size.

2. Plants from material preserved in alcohol, natural size.

3. Thallus-segment, alcoholic material, × 5.

4. Thallus-segment, from dry specimen, × 10.

5. A thick free-hand transverse section from near apex of thallus, showing portions of the scales, × 23.

6. Outline of transverse section from same segment as no. 5 but farther back, × 12.

7–9. Outlines of microtome cross-sections of thallus segment; no. 7, near apex, no. 8, well forward, no. 9, toward base, × 12.

10 and 11. Outlines of cross-sections of thallus-segment from another plant, × 12.

12. Antheridium, showing non-elevated ostiole, × 12.

13. Epidermis near thallus-apex, × 225.

14 and 15. Epidermis from older parts, × 225.

16. Ventral scale, × 23.

17. Portion of thin transverse microtome section of thallus, × 53.

18. Outer face of spore, × 305.

19. Inner faces of spore, × 305.

20. Outline of optical section of spore-wall, showing its relative thickness, × 305.

Figs, 1, 4–6, and 18–20, drawn from specimen collected in Fruit Vale, Alameda County, May 2, 1895; 2, 10, 11, and 13–16, San Francisco, April, 11, 1896; 3, 7–9, 12, and 17, Fruit Vale, February 1, 1896.

7. **Riccia Campbelliana** sp. nov.

Thallus mostly once or twice, occasionally three times, dichotomous, rarely subradiate, reticulate above, brown or nearly concolorous below, very rarely blackening, 4–18 mm. long, 1–3 mm. (mostly 1.5–2 mm.) wide, more or less rounded ventrally, sometimes carinate, furnished beneath with brown or nearly colorless scales, these usually inconspicuous, but sometimes at the apex slightly exceeding the thin, naked, membranous, commonly yellowish-brown, now and then rather abruptly winged margins, median sulcus acute, often obscure toward basal parts, the margins, on drying usually ascending, erect, or inflexed-connivent; terminal lobes oblong or obovate, obtuse, less commonly subacute; transverse sections, including margins, 2–5 (mostly 2½) times broader than high, thickness of thallus 25–35 cells in median parts, air-canals narrow; cells, often enlarged, densely filled with a finely granular, yellowish-brown material or with a homogeneous yellow oily substance, sometimes occurring abundantly in all parts of the thallus; epidermis primarily unistratose, the cells large, oblong-elliptical in vertical section or subquadrate-elliptical, mostly higher than broad (40–75 μ × 25–50 μ), long intact, disintegrated in the older parts and replaced by an irregularly developed subjacent layer: spores finally yellowish-brown, 75–108 μ (mostly

90–100 μ) in maximum diameter, distinctly angular, with a minutely granulate or nearly smooth margin 3–6 μ width, the outer face lightly papillate or nearly smooth in profile, marked with close sinuous ridges which rarely form completely closed meshes, the imperfect areolae mostly 4–7 μ in width, inner faces similarly but less strongly marked.

Near Stanford University (Professor D. H. Campbell, Feb. 6 and May 1, 1896); on hills above Mission Dolores (534, April 11, 1896, with *R. nigrella* and *R. trichocarpa*); Fort Ross, Sonoma Co. (March 15, 1896); Ukiah (May 13, 1896). Collected by Professor Campbell also in 1893 (herb. Underwood).

Riccia Campbelliana in its smaller forms simulates to a certain extent *R. nigrella*, with which it is sometimes associated, but is always readily distinguished by the wider and usually longer segments, which are commonly brown underneath, very rarely blackening, by the thinner brown margins, by the larger spores and the elevated antheridial ostioles. The epidermis, too, differs from that of *R. nigrella*, its cells being larger and commonly having their vertical axis longer than the horizontal, while those of *R. nigrella* are subquadrate in vertical section and are quite frequently broader than high, measuring 25–40μ in height by 25–45μ in width.

The larger conditions of this species are somewhat suggestive of *Riccia Bischoffii* Hüben. and *R. Gougetiana* Mont.,* especially when, as sometimes happens, the thallus is rather abruptly wing-margined, but the Californian plant differs clearly from both these in being monoicous, in the usually smaller size, in the entire absence of cilia, in the smaller, lighter colored, much more translucent spores, etc.

Riccia lamellosa Raddi is easily distinguished from the larger forms of *R. Campbelliana* by the much more prominent scales, the usually less attenuate concolorous margins, the different epidermis, three or four layers of cells next to the dorsal surface of the thallus in *R. lamellosa* being commonly echlorophyllose, and by the entire absence, so far as we have observed, of oil-bodies. *R. lamellosa* is described by Herr Stephani† as dioicous and our investigations on Italian material point toward the same conclusion, though we have been able to see no antheridia.

* We have seen an authentic specimen of this from the Montagne Herbarium through the courtesy of Mons. Paul Hariot of the Muséum d'Histoire Naturelle of Paris.

† Bull. Herb. Boiss. 6: 341. 1898.

The specimen collected by Professor Campbell near Stanford University on May 1, 1896, we consider the type of the species. This specimen, so far as we have noticed, does not contain the oil-bodies referred to in the description, but such occur sparingly in the previously collected specimen now preserved in the Underwood Herbarium and are very abundant in alcoholic material from the same locality communicated by Professor Campbell. These are present also in the San Francisco plant, but are sparingly developed or absent in the specimens from Fort Ross and Ukiah. Allusion is made in our remarks under *R. nigrella* to the occasional behavior of the contents of the epidermal cells when treated with iron-haematoxylin.

PLATE 91, FIGS. 1–15. RICCIA CAMPBELLIANA.

1. Plant, dry, natural size.

2 and 3. Plants from soaked-out dried material, natural size.

4. Terminal portion of thallus-segment, × 10.

5–8. Outlines of transverse sections of thallus-segments, × 12.

9. Outline of transverse section of an unusually wing-margined thallus-segment, × 23.

10. Papilliform elevation of antheridial ostiole, × 53.

11 and 12. Thin transverse sections showing epidermis and cells containing "oil-bodies," × 53, the latter section from an older part of the thallus.

13. Cell from older part of thallus containing "oil-body" which here appears densely granular (yellowish-brown in the alcoholic material), × 225. The adjacent cells contain chloroplasts and starch-grains.

14 and 15. Spores, × 305.

Fig. 1 drawn from specimen collected at Fort Ross, March 15, 1896; 2, 9, 14, and 15, near Stanford University (Professor Campbell, May 1, 1896); 3 and 5, near Stanford University (Professor Campbell, February 6, 1896); 4 and 8 (Professor Campbell, 1893, *ex herb.* Underwood); 6, 7, and 10–13, from alcoholic material sent by Professor Campbell.

8. RICCIA NIGRELLA DC. Fl. Fr. **5**: 193. 1815. Lindenb. Nova Acta Acad. Caes. Leop.-Car. Nat. Cur. **18**: 466. *pl. 29.* 1836.

Riccia minima L. *p.p.* Sp. Pl. 1139. 1753.

Riccia aggregata Underw. Bot. Gaz. **19**: 275. 1894.

Thallus at first subradiate, later commonly forming irregularly confluent masses, dark green, somewhat polished and closely reticulate above, dark purple or nearly black beneath, with transverse, semicircular, blackish-purple, nitent scales, which do not exceed the margin; principal divisions 2–8 mm. long, at first simple and obovate, finally linear or linear-obcuneate and 1–3 times dichotomous; terminal lobes 1–1.5 mm. wide, obcuneate-oblong or ellip-

tical-obovate, obtuse or subacute, narrowly canaliculate, the margins often brownish, acute, entire, slightly membranous, becoming rather obtuse toward the base, often erect-connivent on drying; width of transverse sections 1–2.5 (mostly 1.5–2) times their height, their ventral boundary nearly rectilinear, slightly convex toward the apex, the air-chambers narrow and inconspicuous; epidermis of a single layer of cells, these lightly protuberant, subquadrate in vertical section and often broader than high, 25–40 μ × 25–45 μ, filled with a transparent and colorless or slightly grumous, somewhat refringent fluid, collapsed and disintegrated only in the oldest parts of the thallus: monoicous: antheridial ostioles but slightly or not at all elevated: capsules often numerous, crowded together near the bases of the segments, hemispherical-protuberant above together with the naked, usually light brown, long intact covering, this commonly with a small purple spot about the exserted archegonium-neck; spores brown, becoming darker and more opaque with age but usually translucent in glycerine, 60–78 μ in maximum diameter, angular, with a minutely granular or nearly smooth, sometimes interrupted margin 3–6 μ in width, the outer face with irregularly anastomose-reticulate ridges, lightly papillose or almost smooth in profile, the inner faces usually finely and somewhat regularly reticulate, with thick-walled meshes.

EXSICC. Hep. Bor.-Am. 140b.
Hep. Am. 165.

In rather dry exposed places, especially about rocks, often accompanied by *Riccia trichocarpa* and *R. minima*.

San Francisco: near the Ocean House (Bolander); hills above the Mission Dolores (Howe); Wildcat Cañon, near Berkeley (Howe), Fruit Vale (Miss Byxbee); Mitchell's Cañon, Mt. Diablo (Howe); Pasadena (McClatchie); Twin Oaks, San Diego Co. (F. W. Koch).

The Pasadena plant (*R. aggregata* Underw.) differs from the European and from the specimens of the San Francisco region in the more regularly and finely reticulate outer face of the spore, but this character shows considerable variability even in the Pasadena specimen and hardly justifies, we think, a specific separation.

The dorsal epidermis in *R. nigrella* is very different from that of any other *Riccia* we have examined. Its cells are for a long time turgid with a nearly transparent fluid which takes an intense violet stain when sections of the thallus are treated for several hours with solutions of haematoxylin. We found especially fa-

vorable for this purpose Heidenhain's iron-haematoxylin method (Zeit. f. wiss. Mik. 9: 204. 1892. Lee, Microtomist's Vade-Mecum, 175. 1896 [4th ed.]). The only European specimen of *R. nigrella* (Husnot, Hep. Gall. 96) which we have subjected to this treatment shows the same peculiarity even in the soaked-out dried material. *R. Campbelliana*, especially in forms with numerous oil-bodies, occasionally exhibits something which seems similar at first sight, but in this the epidermal cells which take the haematoxylin stain occur irregularly, are filled with a more granular substance, and appear to be simply cells with oil-bodies like those found elsewhere in the thallus.

Herr Stephani, who, we are informed, has had the opportunity of examining the original specimen of *Riccia aggregata* Underwood describes* it as dioicous; we, however, on making microtome sections of the same type material, find it clearly *monoicous*. Herr Stephani describes the "frons" of *R. nigrella* as "*subtriplo latoir quam crassa*"† while that of *R. aggregata* is "*vix duplo latior quam alta*," but on comparing sections of French and Italian specimens of *R. nigrella* with sections from corresponding regions in *R. aggregata*, we find the differences slight and, we believe, of no specific significance. The length of the frond, the number of times its forking is repeated, and the form of the terminal lobes are variable characters in both the Californian and the European specimens, and, either separately or combined, afford no reliable grounds for specific distinctions.

9. RICCIA CATALINAE. Underw. Bot. Gaz. 19: 275. 1894.

Thallus at first stellate or radiate, often forming later somewhat irregularly intertangled masses, rather loosely attached to the substratum, light green, concolorous below and furnished with a few hyaline very rudimentary scales, the younger parts extremely thin and exhibiting suggestions of a wide-meshed areolation as if from interior air-chambers, the cells of the dorsal surface large, thin-walled, and indistinctly defined (at least in soaked-out herbarium material), the older parts of the thallus spongiose-alveolate from the bursting through of the air-chambers to the upper surface, root-hairs nearly or wholly smooth within; the

* Bull. Herb Boiss. 6: 342. 1898.

† *l. c.* 334.

principal divisions obcuneate-oblong when young, becoming linear, 3–5 times dichotomous, 6–15 mm. × 1–2.5 mm., lightly concave above, with thin, naked, slightly ascending or plane margins; the terminal segments commonly emarginate: monoicous: ostiolar papillae cylindrical, .06–.15 mm. high: capsules in a single or irregularly double series, rather prominent, the covering long intact; spores brown, darkening and rather opaque with age, 90–108 μ in maximum diameter, distinctly angular, with a granulate-crenulate or minutely tuberculate margin 4–10 μ in width, the prominent ridges of the outer face rather irregularly anastomosing, the areolae of the middle of the face, when well defined, usually very large (20–45 μ in diameter) and often enclosing an isolated tubercle or a free-ending spur, the inner faces mostly with tubercles and short free irregular ridges, sometimes with imperfect areolae.

On wet soil in the bottom of a deep cañon, Santa Catalina Island, A. J. McClatchie, Sept. 15, 1893, no. 441.

Riccia Catalinae is a near ally of *R. crystallina* L. from which it differs in the larger size, in the finally 3–5 times dichotomous more elongated divisions, which are less closely adnate to the soil, in the larger spores (60–90 μ in the various European specimens of *R. crystallina* examined), in the much less regular areolation of the spore-faces, and in the considerably larger size of the central meshes of the outer face, when these are well-formed.

The thallus is so thin and so largely occupied by air-chambers that we have been unable, from the dried material, to obtain any satisfactory sections.

PLATE 91, FIGS. 16–20. RICCA CATALINAE.

16. Portion of thallus, dry, natural size.

17. End of young terminal lobe, dorsal surface, showing position of the internal lamellae which bound the air-chambers, × 23. From a soaked-out fragment.

18. Dorsal view of thallus in the older parts, × 23.

19. Spores, × 305.

10. RICCIA CRYSTALLINA L. Sp. Pl. 1138. 1753.

Thallus in closely attached orbicular or suborbicular rosettes 5–15 mm. in diameter, light green on both sides or often tinged with yellow, spongiose with age and vesiculose-alveolate; the principal divisions mostly lobate-obcordate or obcuneate, or sometimes becoming broadly linear and 1–3 times furcate, the segments often close and somewhat crowded, terminal lobes 1.5–2.5 mm. wide, transverse sections 2.5–4 times broader than high, margins naked, subobtuse, slightly elevated on drying or nearly plane, ventral scales wanting;

air-chambers large, epidermis (in dried material) disorganized and indistinct: monoicous: ostiolar elevations prominent, cylindrical, .15–.27 mm. × .05–.07 mm.: capsules rather deeply immersed, scarcely prominent even at maturity; spores soon dark-brown, becoming nearly opaque, 60–90 μ in maximum diameter, distinctly angular, with a narrow, granulate-papillate, sometimes almost deficient, margin (mostly 3–5 μ broad), the convex face with strong anastomose-reticulate ridges, about 7 or 8 imperfectly formed areolae measuring its diameter, those near the middle usually larger (15–30 μ) and sometimes enclosing a free-ending spur, the plane faces marked with short free or irregularly anastomosing ridges, the mature more opaque spores appearing tuberculate-papillate.

On the banks of a stream upon a rocky hillside, southern slope of the Dixey Mts., Lassen Co. (M. S. Baker and F. P. Nutting, July 2, 1894). We refer here also a specimen in herb. Underwood, collected near San Francisco by Mrs. Katharine Brandegee in 1892, which, in the more solid—less conspicuously vesiculose-alveolate—thallus, approaches the closely allied *R. Brandegei* (from the southern extremity of the peninsula of Lower California).

The Lassen County plant seems scarcely to differ from European specimens of *R. crystallina* unless possibly in the greater opacity of the spores when fully mature and in their somewhat narrower margin.

Riccia crystallina is listed in Dr. Bolander's "Catalogue of the Plants growing in the Vicinity of San Francisco."

RICCIA FROSTII Aust. (Bull. Torr. Bot. Club, 6: 17. 1875), originally described from Nevada and Colorado, and since found to be quite widely distributed in the Rocky Mountain region and to extend as far easward as the Mississippi Valley is to be expected in California. It can readily be distinguished from any of the Californian species here described by the small narrowly margined spores, 45–58 μ in maximum diameter, marked almost uniformly over the entire surface by numerous short, delicate, wavy ridges which rarely anastomose; the thallus, which is thin in texture, with a fibrous-reticulate and minutely foveolate surface, becoming lacunose and spongy in the older parts, forms flat, dark- or grayish-green rosettes, 8–15 mm. in diameter, closely adherent to the soil, with numerous narrow usually crowded divisions .5–1.5 mm. wide; the covering of the abundant

capsules is soon ruptured, exposing the spores. *R. Frostii* is dioicous, the male plant (*R. Watsoni* Aust.) being smaller and more or less purple in color, the slenderly cylindrical ostioles elevated about .1 mm.

RICCIA FLUITANS L. Sp. Pl. 1139. 1753.

Thallus thin, green, floating or immersed, often forming intertangled mats, destitute of rhizoids, or becoming terrestrial and attached by root-hairs, repeatedly dichotomous, the segments narrowly linear (.5–1.5 mm. wide, the entire thallus 1–5 cm. long), the median axis thickened, the mostly flat margins only 2- or 3-stratose, air-chambers large, oblique, usually elongated, communicating with the dorsal surface by small pores surrounded by slightly modified epidermal cells: capsules (found only in the terrestrial or semiterrestrial conditions) protuberant below with the enclosing tissues of the thallus, the spores usually set free ventrally, these yellowish-brown, translucent, 70–75 μ in maximum diameter, with a margin 3–6 μ broad, the outer face with rather smooth meshes 12–15 μ in width, inner faces less distinctly areolate.

This species was collected by Messrs. Coville and Funston in Vegas Valley, Lincoln Co., Nevada (Death Valley Expedition, no. 400) and probably occurs within the limits of California.

RICCIOCARPUS Corda; Opiz, Beitr. 1: 651. 1829.*

Plants lemna-like, floating or finally attached to the soil by the subsidence of the water, dark green, sometimes purple-margined, dichotomous, mostly 2–4-lobed, with a very pronounced median furrow, the lobes obcordate or obovate, the ventral surface bearing numerous long, pendant, linear or linear-lanceolate, reddish-violet, dentate scales; colorless ventral layer of thallus much reduced, the chlorophyll-bearing layer composed of large irregularly polyhedral chambers separated by mostly unistratose lamellae; epidermis with small but distinct stomata. Dioicous. Antheridia in an elongated ridge-like androecium situated in the median furrow. Capsule immersed.

The only recognized species is

RICCIOCARPUS NATANS (L.) Corda, *l. c.*

Riccia natans L. Syst. Nat. 1339. 1759 [Ed. 10].

Plants about 1 cm. long, the lobes 4–9 mm. wide: spores 45–55 μ, papillate-areolate, dark-brown at maturity, the areolae becoming obscure and the papillae more prominent.

Rarely found with capsules. This species has not yet been collected, so far as is known, within the limits of the state, but it is found in Oregon and is likely to occur in California.

* It would appear from a statement of M. Auguste LeJolis (Mém. Soc. nation. Sci. nat. et math. Cherbourg, 29: 167. 1894) that a separate of Corda's "Genera Hepaticarum" was published in 1828—in advance of its appearance in Opiz' Beiträge zur Naturgeschichte.

Family II. MARCHANTIACEAE.

Chlorophyll-bearing layer of the thallus (exc. in *Dumortiera*) with well-developed air-chambers, these in most cases containing a loose somewhat filamentous assimilative tissue or soon divided into smaller secondary chambers by chlorophyll-containing lamellae. Stomata (exc. in *Dumortiera*) always present, simple (*i. e.*, the pore surrounded by four or more somewhat modified epidermal cells, all in a single stratum) or dolioform (*i. e.*, the pore surrounded by a barrel-shaped wall, several cells in height, which projects into the underlying air-chamber). Sexual organs nearly always aggregated, often borne on long-stalked, capituliform receptacles.

Capsule short-stalked, breaking through the calyptra at maturity, dehiscing irregularly or by a special lid, rarely valvate. Spores always accompanied by sterile cells, which (exc. in the *Corsinioideae**) are developed as elaters.

Key to the Genera of the Marchantiaceae.

Sporogonium single, underneath the apical margin of the thallus, enclosed by an involucre consisting of two rigid, brown or dark purple valves which, previous to the maturity of the capsules, are united in a vertical keel-like suture. 2. *Targionia.*

Sporogonia in groups on stalked receptacles.

Stomata dolioform; antheridia on a disk-shaped receptacle; ♀ receptacles (in our species) with 8–11 finger-like, usually decurved rays; gemmae in dorsal, cup-shaped, dentate-margined receptacles. 10. *Marchantia.*

Stomata of the thallus simple

Always gemmiferous, the gemmae in dorsal, crescentic, entire-margined receptacles. Found in or about greenhouses. 9. *Lunularia.*

Never with gemmae-cups.

Thallus large (5–25 cm. × .75–1.5 cm.) areolae very distinct, the elevated stomata easily visible without magnification. The uppermost cells of the thin, sharp'y defined, chlorophyll-bearing layer each with a conical or long-cylindrical colorless beak. 8. *Conocephalum.*

Thallus smaller (less than 5 cm. long in the Californian species), cells of the chlorophyll-bearing stratum never with a colorless beak.

Sporogonia each surrounded by a membranous, white or sometimes violet pseudoperianth, this at first somewhat conical, usually much exserted, finally more or less completely divided longitudinally into 3–18 narrow segments. 7. *Asterella.*

Pseudoperianths wanting or very rudimentary.

♀ branch arising from the dorsal surface of thallus, the peduncle without a root-hair furrow; stomata normally stellate (*i. e.*, the cells bounding the pore have the radial walls strongly thickened). 3. *Clevea.*

* This subfamily is not represented in North America, so far as is now known.

♀ branch arising from apex of thallus or thallus-lobe, the peduncle with a single root-hair furrow,* stomata not stellate.

Thallus thin; air-chambers large and empty, separated by mostly unistratose lamellae; antheridia immersed in the thallus in an elongated, single or irregularly double median row just back of the peduncle, ostioles inconspicuous; ♀ receptacle finally disciform. 6. *Cryptomitrium.*

Thallus somewhat firm and rigid, the primary air-chambers soon filled by secondary walls; ♀ receptacle hemispherical or subconical.

Capsule at maturity completely filling the broadly campanulate involucre and protruding. 5. *Grimaldia.*

Involucre conchoid-bivalved, its cavity only partially filled by the capsule. 4. *Reboulia.*

2. TARGIONIA L. Sp. Pl. 1136. 1753. Ex Mich. Nov. Pl. Gen. 3. *pl. 3.* 1729.

Thallus usually rather thick and coriaceous, simple or once or twice dichotomous, innovating at apex or often latero-ventrally, broadly costate, areolae mostly indistinct, stomata simple, the white-margined pores more or less conspicuous; chlorophyll-bearing layer sharply defined, the chambers filled with branched "conferva-like" filaments, epidermal cells thick, their walls with trigones; ventral scales reaching to margin or much reduced. Gemmae none. Androecium small, disciform, terminating a short latero-ventral shoot. Archegonia in a group of several arising just back of the apex of the thallus, becoming apparently ventral by the over-arching of the surrounding dorsal tissues, without a special receptacle, a single archegonium of the group ordinarily maturing a sporogonium, this soon surrounded by a somewhat laterally compressed, obovoid, subglobose, or hemispherical 2-valved involucre, the anterior margins of the latter uniting to form a median vertical keel-like suture, finally gaping widely and exposing the capsule, the valves rigid, entire-margined, brown or dark purple, at times iridescent. Pseudoperianth none. Sporogonium consisting of a subglobose capsule, a very short pedicel, and a bulbous foot; capsule dehiscing irregularly, its wall of a single layer of cells with annular or spiral thickenings. Spores opaque, nearly spherical, the outer membrane thrown into ridges and wart-like folds, loosely investing the firmer inner coat and occasionally caducous, the entire surface minutely and irregularly reticulate or granulate. Elaters 2–4-spiral, often branched.

* See footnotes on following pages under generic diagnoses of *Reboulia* and *Grimaldia* and also remarks upon *Cryptomitrium* in Erythea, 5: 87. 1897.

1. TARGIONIA HYPOPHYLLA L. *l. c.*

Thallus mostly simple, sometimes dichotomous, obovate to sublinear, commonly linear-obcuneate, progressing chiefly by latero-ventral or apical innovations, 4–20 mm. long, 2–5 mm. in maximum width, rounded or slightly emarginate at apex, reddish-brown or dark-purple beneath, the margins usually involute or erect-connivent on drying, colorless stratum of about 25 layers of cells in axile parts, rather suddenly reduced to the ventral epidermis toward the lateral margins; scales densely imbricate, the superior extending to the margin, often abruptly contracted to a narrow, sometimes twisted, subentire or ciliate-dentate apical appendage: monoicous: spores brown, 58–80 μ; elaters 180–330 μ $\times$ 6–12 μ, subacute or obtuse.

Exsicc. Hep. Bor.-Am. 137 (as *Targionia Michelii* Corda).
Hep. Am. 159.

On shaded banks, mostly in rocky soil. Common, particularly in the Coast Range Mountains from San Diego to Humboldt County, and extending northward to Vancouver Island (Macoun). Berkeley; San Francisco; Sausalito, Mill Valley; Sonoma (F. T. Bioletti), Duncan's Mills; Ukiah (746) and Big River Boom (681), Mendocino Co.; Blue Lake (997), Humboldt Co.; Oak Run, Shasta Co. (Baker and Nutting); Jackson, Amador Co. (George Hansen); Ojai, Santa Barbara Co. (W. F. Hubby) Nordhoff, Ventura Co. (Miss Jacqueline K. Newton); Pasadena (A. J. McClatchie); San Bernardino (S. B. Parish); San Diego (W. G. Farlow) and Twin Oaks (F. W. Koch), San Diego Co.; Surprise Cañon, Inyo Co. (Coville and Funston, Death Valley Expedition, no. 619); also, by the last named collectors, in Lincoln Co., Nevada. First found in California by Dr. Bolander.

3. CLEVEA Lindb. Not. ur Sällsk. pro Fauna et Flora Fenn. **9**: 289. 1868.

Thallus usually small, simple or once dichotomous, sometimes innovating from the apex, distinctly areolate, the areolae but slightly elevate-pulvinate, the cells bounding the stomata with (typically) strongly thickened radial walls; air-chamber layer of numerous empty cavities with mostly unistratose dissepiments, these cavities appearing in several series in the median portions in a cross section, occupying the greater part of the axial thickness of the thallus and composing the whole of the wings, being gradu-

ally or rather abruptly reduced to a single series toward the thin thallus-margins ; postical scales numerous, hyaline, at least at their apices, or rarely purple throughout, obtuse, acute or long-acuminate, the anterior usually exceeding the margin of the thallus and often conspicuous. Dioicous. Antheridia immersed, scattered near the median line of the thallus, with slender subcylindrical ostiolar papillae. ♀ branch from the median dorsal surface of the thallus, commonly arising at a considerable distance back of the apex, single or in a linear series of 1–4. Peduncle subpellucid, without a root-hair furrow. ♀ receptacle consisting simply of the 4 (–1) obovoid somewhat downwardly inclined involucres, these lightly compressed laterally and bilabiate about to the middle by a vertical cleft, affixed directly to the top of the peduncle or slightly connate at the bases. Pseudoperianth none ; capsule nearly sessile and included or subexserted by a somewhat elongate pedicel, its walls on dehiscence cleft to the middle or below into 3–8 irregular valves, the cells with numerous annular or spiral thickenings. Spores yellowish, red, or brown, densely covered with rather large obtusely conical papillae. Elaters 2–4-spiral.

1. CLEVEA HYALINA (Sommerf.) Lindb. Not. ur Sällsk. pro Fauna et Flora Fenn. 9 : 291. 1868.

Marchantia hyalina Sommerf. Mag. Naturv. II. 1 : 284. 1833 (*fide* Lindberg).

Plagiochasma erythrosperma Sulliv.; Aust. Proc. Acad. Nat. Sci. Philad. 1869 : 229. 1869.

Thallus strongly concave or canaliculate above, narrowly oblong to obovate, obcordate at the apex, simple or once forked, 5–15 mm. long, 2–6 mm. in greatest width, scales mostly numerous and persistent, conspicuously projecting, with rare exceptions, and the anterior often inflexed, hyaline, sometimes purple at base, rarely purple throughout, acute or acuminate, the occasionally subtubulose points with crenulate margins: peduncle usually single, 2–15 mm. high ; ♀ receptacle 2.5–4 mm. broad, with long and numerous white or purplish paleae beneath : capsule dehiscing by 3–6 irregular valves, the wall-cells with annular thickenings ; spores 44–60 μ, reddish-brown, rarely verging toward yellow or darkening ; elaters 120–300 μ long, 8–15 μ in greatest width, often bispiral at the extremities, in the middle mostly tri-, rarely quadrispiral.

About rocks in mountainous regions, especially northward. " Near a lake on the trail to the White Chief Mine, 1100 ft. above Mineral King, Tulare Co." (Coville and Funston, Death Valley

Expedition, Aug. 6, 1891, no. 1511); also, by the same collectors, "near White Chief Mine" (no. 1528).

1b. **Clevea hyalina Californica** var. nov.

*Santeria limbata** Aust. *p. p.* Proc. Acad. Nat. Sci. Philad. 1869: 229. 1869.

Thallus often once dichotomous, with strongly pronounced radial ridges or undulations on the ventral surface toward the thin margin, very distinctly areolate, pores in the median parts large and elliptical, often 50–150 μ in length, the radial walls of the bounding cells unthickened, the pores near the margin smaller, with the radial walls of the surrounding cells more or less clearly incrassate, scales purple or slightly decolorate at their extremities, exceeding the margin: peduncle delicate, slender, 25–32 mm. high, with few and rather inconspicuous paleae at the apex; involucres for the most part strongly discrete: capsule finally subexserted, the pedicel attaining a length of 2 mm.

Doolan's Creek Cañon, near Ukiah, May 13, 1896 (Howe, no. 765); a specimen collected by A. J. McClatchie on the trail to Wilson's Peak, San Gabriel Mts., April, 1893, has more in common with this variety than with the typical form, though the peduncles are shorter, the capsules sometimes subsessile, the areolation is less distinct, and the guard-cells of the stomata have more strongly thickened radial walls. Professor McClatchie's plant differs, too, from both the Ukiah specimen and the typical *C. hyalina* in the very slender inconspicuous scales with almost filiform points.

The Ukiah plant is a remarkable one, and it is with misgivings that we refer it to *Clevea hyalina* as a mere variety, but the Wilson's Peak specimen, though somewhat aberrant in scale-characters, bridges over the gap in respect to the stomata and in some other particulars, as noted above. The form possibly needs comparison with *Clevea pedicellata* (*Plagiochasma pedicellatus* Griff. Not. ad Pl. Asiat. 2: 331. *pl. 68. f. 2.* 1849) from Afghanistan, though the latter would appear from figure and description to differ at least in 8- or 9- instead of 4- or 5-valved capsule.

Mr. Austin, who published "*Plagiochasma erythrosperma*" from a plant thus labeled (with, however, a query-mark after the "n. sp."),

* For remarks on the use of the name *limbata*, see footnote under *Asterella Californica*.

in the Sullivant collection, was apparently the first to recognize that the name was a synonym for *Clevea hyalina*, as is attested by a pencil inscription in Austin's handwriting on the pocket containing the original specimen, now in the herbarium of Harvard University. The several plants since collected in the mountainous regions of the western United States and British America, and identified with this species of Sullivant's, though quite variable, cannot, we think, be satisfactorily distinguished from the *Clevea hyalina* of Europe. The spores, however, often incline more to red, and the thallus is sometimes proportionally broader.

Of true *Sauteria*, we have seen the following three American specimens, probably all referable to *Sauteria alpina* (Nees & Bisch.) Nees: "under rocks, Sulphur Mts., Banff, J. Macoun, 16 July, 1891, no. 345;" "under rocks, Lake Agnes, 7000 ft., J. Macoun, 19 Aug., 1891, no. 364"; St. Paul Islands, Pribiloff Group, Behring Sea, 1897 (Mr. Trevor Kincaid).

4. REBOULIA Raddi (as *Rebouillia*) Opusc. scientif. di Bologna, 2: 357. 1818.*

Asterella Pal. de Beauv. *p. p.* Encyc. Meth. Bot. Suppl. 1: 502. 1810.

Thallus coriaceous and rigid, dichotomous, usually, also, innovating at the apex, broadly costate, scale-bearing and dark-purple or brownish beneath, the dorsal surface without evident areolation, provided with small scattered simple stomata, epidermal cells with trigones: chlorophyll-bearing layer strongly developed, passing gradually into the colorless stratum, the latter limited to the region of the costa, cells with oil-bodies occurring here and there in both, air-chambers at first simple, their limits afterwards obscured by more or less numerous secondary walls; root-hairs numerous, colorless. Gemmae none. Androecium sessile or somewhat sunken, in the median line of the thallus, disciform, suborbicular or with a lunate sinus in front, often surrounded by a few narrow scales. ♀ receptacle conical or hemispherical, becoming at times nearly plane above, paleaceous-barbate beneath, containing air-chambers and furnished with dolioform stomata, cleft about to the middle into 1–6 (commonly 4 or 5) thick, often spreading lobes, the membranous ventral margins of these forming the conchoid-bivalved involucres, each of the latter enclosing a single sporo-

* This citation is as given by authors We have been unable to see the original paper.

gonium. Pseudoperianth wanting. Peduncle from the apex of the thallus-lobe, with a single root-hair furrow, * destitute of assimilative tissue, surrounded at the base by a few narrow, whitish or purple paleae, the receptacle conspicuously involucrate when young and sessile. Sporogonium consisting of a subglobose capsule, a scarcely perceptible pedicel, and a large foot. Capsule only partially filling the involucral cavity, yellowish-green, the apical portion of its wall falling away in fragments at dehiscence, leaving behind a subhemispherical urn with an erose-dentate margin, the cells without annular or spiral fibers, those in the apical region with trigones or sometimes exhibiting irregular nodulose thickenings in the lateral walls. Spores yellow or brownish, more or less distinctly tetrahedral, all the faces with rather large often irregular areolae, the angles pellucid-margined, membrane finely granulate. Elaters 2–4- (mostly 3-) spiral.

1. REBOULIA HEMISPHAERICA (L.) Raddi, *l. c.*

Marchantia hemisphaerica L. Sp. Pl. 1138. 1753.

Asterella hemisphaerica Pal. de Beauv. Encyc. Meth. Bot. Suppl. 1: 502. 1810.

Thallus 6–30 mm. long, rather pale green above, the segments emarginate at apex, obcuneate or obcordate, less commonly elongated, margins undulate-crenulate: monoicous: peduncle mostly 1.5–3 cm. in length, rarely longer: spores 65–80 μ; elaters 300–450 μ long, 10–12 μ in maximum width, the apices subobtuse.

A cosmopolitan species, but the only Californian station we can cite is Folsom (Katharine Brandegee).

5. GRIMALDIA† Raddi, Opusc. scientif. di Bologna, 2: 356. 1818.‡

Thallus somewhat firm and rigid, broadly costate or sometimes sharply carinate, dichotomous and often innovating at the

* Schiffner in his key to the Marchantiaceous genera in Engler & Prantl, Nat. Pflanzenfam. 1[3]: 25, denies a "Wurzelrinne" to *Reboulia*, but we find it always present, as described by Nees, Limpricht, and others, both in European and American forms of the plant.

† We are not unmindful of the fact that *Grimaldia* is said to have been used by Schrank in 1805 and 1808 as a generic name for certain species of phanerogams, which by later writers have been almost universally referred to *Cassia* or to *Chamaecrista* (Breyne, 1678; Moench, 1794). There can, therefore, be no doubt that a literal carrying out of Article IV. of the Rochester Code would call for the disappearance of *Grimaldia* from among the names of genera of Hepaticae, and indeed from all botanical literature save the strictly historical, unless, perchance, some one should find grounds for recognizing again the *Grimaldia* of Schrank as a genus. But until some one actually proposes to revive the older *Grimaldia*—if that time ever comes—it seems to us to be conducive to clearness to retain in use the only "*Grimaldia*" that has been generally known to botanists for the past eighty years.

‡ See footnote under *Reboulia*.

apex or latero-ventrally, mostly dark purple beneath, dorsal surface very indistinctly areolate, furnished with simple inconspicuous stomata, epidermis thick, the walls of its cells more or less thickened at the angles, chlorophyll-bearing layer deep, passing gradually into the colorless stratum, somewhat inflated cells with oil-bodies often occurring in both, the primary air-chambers soon filled by secondary walls: scales extending to the margin or projecting and inflexed at the thallus-apex, purple or vinous-red, sometimes conspicuously hyaline-pointed or nearly colorless throughout. Gemmae none. Monoicous, dioicous, or polyoicous. Antheridia immersed near the median line of the thallus, sometimes at about the middle of a segment, but mostly forming a papillate androecium near an apical sinus, the androecium surrounded by the slightly elevated adjacent tissues or wholly destitute of a special involucre, covered occasionally by the inflexed thallus-margins. ♀ receptacle with a single archegonium in each of the 3 or 4 short lobes, maturing 1–4 sporogonia, finally long-stalked, hemispherical-umbonate or subconoidal, commonly papillate above, the lobes at maturity mostly directed downward, rarely somewhat spreading, often obscurely defined. Peduncle from apex of the thallus or from a small latero-ventral innovation, with a single root-hair canal,* more or less paleaceous-involucrate at base, clothed underneath the receptacle with pendant, often white, paleae, these sometimes obsolete or wholly wanting. Involucres broadly campanulate, continuous with the lobes, the margins repand. Pseudoperianth none or rudimentary. Capsule globose, completely filling the involucres and protruding, circumscissile above the middle, cells of its wall destitute of annular thickenings or with traces of such at the margin of the thicker operculum, pedicel very short. Spores yellow, brown or dark violet-purple, tuberculate, rugose, or sometimes rather regularly areolate. Elaters 2–4-spiral, often somewhat attenuate toward the extremities.

1. GRIMALDIA CALIFORNICA Gottsche; Underw. Bot. Gaz. **13**: 114. 1888. Bolander, Cal. Med. Gaz. 1870: 184 (40) (name only). 1870.
Grimaldia Californica Steph. Bull. Herb. Boiss. **6**: 794. 1898.
Thallus linear or spatulate-oblong, 6–20 mm. × 1.5–4 mm.,

* The peduncle of *Grimaldia* is said by Schiffner in his key to the genera of the Marchantiaceae to be without a "Wurzelrinne" (Engler & Prantl, Nat. Pflanzenfam. 1^3: 25), but it is surely present in *G. Californica*, *G. pilosa*, *G. androgyna* (*Marchantia androgyna* L. *pro parte maxima*, *Grimaldia dichotoma* Raddi) and in American specimens of *Grimaldia fragrans*; it seems, however, to be sometimes only rudimentary in European specimens of *G. fragrans*, though attributed to the species without reservation by Nees and by Limpricht.

dichotomous, or progressing by latero-ventral, very rarely apical innovations, broadly costate, 25–30 cells thick in median parts, mostly crescentic in cross section with broad, thin, often erect or inflexed, commonly purplish margins, the air-chambers almost wholly filled by secondary walls, leaving very small lacunae; ventral scales purple, closely imbricate, the inferior reniform or obliquely ovate, subentire or irregularly dentate, extending to the margin, the superior ovate or lanceolate, rather abruptly narrowed to a slender, acuminate, often bifid, subnodose or repand point, slightly exceeding the margin and inconspicuously inflexed at the apical sinus, their tips rarely decolorate: polyoicous: antheridia immersed, with short-papilliform ostiola, somewhat scattered near the middle of a thallus-segment or aggregated near the apex, without special involucre, the androecium when subapical often more or less covered by the inflexed thallus-margins: peduncle from the apex of a small obovate or cordate latero-ventral innovation, 1.5–2.5 cm. high, mainly reddish, pale above, with a few small purple scales at base, naked beneath the receptacle or obsoletely palaceous; ♀ receptacle small, 1.5–2.25 mm. in maximum width, hemispherical-conoidal, lightly papillate above, obscurely lobed, maturing 1–4 sporogonia: capsule purplish; spores dark violet-purple, 55–75 μ, obscurely angular, tuberculate-verrucose especially on the outer face, the often loose and saccate exterior membrane of the inner faces commonly rugose or irregularly areolate, entire surface minutely papillate or granulate; elaters 2–4- (mostly 3-) spiral, purple both as to the bands and the unthickened wall, often considerably attenuate at one or both extremities, 200–300 μ long, 9–15 μ in greatest width.

Yosemite Valley, "on rocks in the spray of Bridal Veil Fall, June, 1866" (Bolander); also in the region of the Yosemite Valley by C. M. Cooke, Jr., 1896 (in herb. A. W. Evans); on trail to Wilson's Peak, San Gabriel Mts. (A. J. McClatchie, Apr. 21, 1893).

A portion of Bolander's original, communicated by Dr. Gottsche to Professor Underwood, is in the Underwood Herbarium. Other specimens from the first collection are in the herbaria of Professor Underwood, of Columbia University, and of the U. S. National Museum.

Grimaldia Californica is somewhat nearly allied to *Grimaldia androgyna* (L.) Lindb. of Southern Europe, but clearly differs in the purple elaters, the dark purple spores, the broader thallus with thinner margins, the rather smaller, more conoidal, less evidently

lobed ♀ receptacles, in the origin of the peduncle from a small latero-ventral innovation, which seems to occur rarely in *G. androgyna*, and in other characters of less moment.

PLATE 92. GRIMALDIA CALIFORNICA.

1. Plant, natural size.
2. Thallus, with androecia and vegetative latero-ventral innovations, × 3.
3. Thallus, with androecia and peduncle-bearing innovation, × 3.
4. Thallus, with peduncle-bearing innovations, × 3.
5. ♂ thallus, × 3.
6. Transverse section of thallus, × 12.
7. Transverse section of thallus through androecium, × 12.
8. Transverse sections of mature peduncles, × 29.
9.–13. Outlines of ventral scales, mostly from near thallus apex, × 29.
14. Stoma and adjacent epidermal cells, × 305.
15–17. ♀ receptacles (containing dehisced capsules), × 4.
18. Ventral view of receptacle with dehisced capsules, × 8.
19. Spores, × 305.
20. Elater, × 305.

All figures drawn from soaked out dried specimens; 1–4, 6, 8, 9, 11, and 14–20, from portions of the original material collected by Dr. Bolander and preserved in herb. Underwood (partly communicated by Dr. Gottsche and partly from U. S. National Herbarium); 5, 7, 10, 12, and 13, from specimen collected by Professor A. J. McClatchie in the San Gabriel Mts.

6. CRYPTOMITRIUM Aust.; Underw. Bull. Ill. State Lab. Nat. Hist. 2: 36. 1884.

Platycoaspis Lindb. Kongl. Sv. Vet. Akad. Handl. 23^5: 11. 1889.

Thallus thin, green and often somewhat polished above, concolorous or purple beneath, 6–15 mm. long, 1–3 times irregularly dichotomous, with the inner margins of the terminal segments now and then connate, sometimes progressing by apical or lateral innovations from the rather thick costa, the segments obovate, obcordate, or oblong, 3–9 mm. in maximum width, venulose-areolate, stomata simple, the minute pores surrounded by several finally oblong cells with unthickened radial walls; scales small, violet-purple, irregularly biseriate, broadly ovate, variously lobed, extending half way to the margin or fragmentary and inconspicuous; air-chamber layer of large empty cavities separated by mostly unistratose lamellae, these chambers in 3–5 layers over the costa in transverse section, occupying the whole of the very thin alar expansion and reduced to a single layer at the margin, the latter green or brownish-purple, undulate-repand or crenate, slightly as-

cending when dry, furnished with a unistratose border 1–3 cells in width; costa (exclusive of air-chamber layer) 15–20 cells in thickness, gradually attenuate to the wing on either side. Monoicous. Antheridia immersed in the thallus just posterior to the base o the ♀ branch, in a single or irregularly double, often much elongated, row, each completely filling the loculus at maturity and adnate to its walls, ostioles papilliform, inconspicuous. ♀ branch from the apex of the costa. Peduncle slender, naked throughout, pale or sometimes brownish-purple below, irregularly sulcate, the dorsal (posterior) face without assimilative tissue, the ventral (anterior) face with a single root-hair furrow.* ♀ receptacle subhemispherical in early stages, soon becoming circular-disciform, lightly convex and somewhat papulose above, plane and naked beneath, much attenuated toward the crenate margin, furnished with 3–7 (commonly 5) radiating root-hair canals in communication with the root-hair furrow of the peduncle, these reaching a little more than halfway to the margin, surrounded by a compact tissue, and, after drying, sometimes appearing costa-like; air-chambers large, in a single layer, with dolioform stomata; archegonia in groups of four, alternating with the root-hair canals, one archegonium of each group (very rarely two) producing a sporogonium. Sporogonia (3–7, usually 5) occupying ellipsoidal radiately disposed loculi reaching commonly a little more than half the distance to the periphery of the receptacle, the margins of the loculus early connivent and enclosing the capsule, separating later by an elongated radial cleft, this finally gaping and widely exposing the capsule, the lips becoming membranous-scarious, remaining somewhat elevated, and functioning as the only involucre. Calyptra inconspicuous. Capsule nearly spherical or oblately ellipsoidal, the apical third or fourth of its wall consisting of two layers of cells and falling away as an operculum in dehiscence, the wall otherwise unistratose, the cells without annular or spiral thickenings, those of the operculum with the walls slightly thickened at the angles. Seta very short, foot bulbous. Spores brown, more or less distinctly tetrahedral, irregularly areolate-lamellate, with a pellucid margin. Elaters attenuate, contorted, often branched, closely 2-(3-) spiral.

The only recognized species is

* Herr Stephani (Bot. Gaz. 17: 58. 1892) has described the peduncle of Californian specimens of *Cryptomitrium* as bicanaliculate. In his latest paper on the subject (Bull. Herb. Boiss. 7: 222. 1899) he reports that in Chilian plants he finds the peduncle with one or with two root-hair furrows in one and the same specimen. In our investigations upon Californian material and the Hookerian type, we have as yet been unable to find any peduncle with more than one furrow containing root-hairs.

1. CRYPTOMITRIUM TENERUM (Hook.) Aust. l. c. Stephani, Bot. Gaz. **17**: 58. 1892. Bull. Herb. Boiss. **7**: 222. 1899. Howe, Erythea, **5**: 87. *pl. 3.* 1897.

Marchantia tenera Hook.; Kunth, Syn. Pl. **1**: 46. 1822.

Duvalia tenera Gottsche; G. L. & N. Syn. Hep. 554. 1846.

Peduncle 15–30 mm. × .3—.5 mm.: spores 35–50 μ; elaters 300–450 μ long, 7–11 μ in greatest width.

On moist shaded banks. Fruit Vale, Alameda Co. (Miss Edith S. Byxbee, Howe); Navarro, Mendocino Co. (*fide* Miss Byxbee); Menlo Park (Blasdale); Folsom (Mrs. Brandegee); Jackson, Amador Co. (Hansen); San Bernardino (Parish, no. 2221); Pasadena (McClatchie). Also collected in California by Parry, Bigelow, Bolander, and Torrey (*fide* Austin).

The original plant of Hooker was collected near Ario [State of Michoacan (?)] Mexico, by Humboldt. A portion of this, bearing the legend "no. 236, *Marchantia tenera*, n. sp.," Legit "Humboldt," has been sent to Professor Underwood through the kindness of Dr. W. T. Thiselton-Dyer, the Director of the Royal Botanic Gardens at Kew, and is deposited in the herbarium of Columbia University. This fragment, rather unfortunately, bears only very young capsules, so we have been unable to compare spores and elaters, but it seems to agree essentially with the Californian plant in structure of thallus and peduncle, form of ♂ receptacle, position of antheridia, etc. The peduncles are, however, much shorter, being only 3 or 4 mm. high, but this may be due, in part, to the immaturity of the receptacle; they are, moreover, only about half as thick as in the Californian specimens, which may, perhaps, be partly accounted for by the possibility that after so many years' drying they may not fully regain their natural size on soaking out.

Duvalia brevipedunculata Mont. from Chili (*legit* Gay) is thought by authors to be the same species. The Californian plant is, however, in need of further comparison with those of Mexico and Chili.

PLATES 93 AND 94.

CRYPTOMITRIUM TENERUM.

1–4. Principal segments of thallus, natural size; fig. 2, with a fully developed ♀ receptacle and peduncle.

5. Ventral view of a thallus-segment, × 3.

6. Thallus-lobe showing young ♀ receptacle and position of antheridia, × 3.

7. Margin of thallus-lobe, dorsal view, showing position of the internal lamellae which mark the boundaries of the air-chambers, × 23 (from alcoholic material).

8. Outline of median longitudinal section of thallus with antheridia and young ♀ receptacle, × 23.

9. Portion of a transverse section of a thallus-lobe, passing through androecium × 23.

10. Median region of a transverse section (about 10 μ in thickness), passing through androecium, × 41.

11. Marginal region of the same transverse section, × 41.

12. Anterior margin of thallus-lobe from a slightly oblique longitudinal section, × 225.

13 and 14. Outlines of cross-sections of mature peduncles, × 53 (dried material).

15. Outlines of cross-sections of a peduncle from the original material of "*Marchantia tenera*" collected in Mexico by Humboldt, × 53.

16. Section of young peduncle, × 50.

17. Stoma, surface view, × 225.

18. Transverse section of thallus-apex with young ♀ receptacle, × 23.

19. Vertical section through ♀ receptacle with mature sporogonium (slightly schematized), × 23.

20. Vertical section of a young ♀ receptacle about half way between the vertical axis and periphery, traversing one of the "costae" with its root-hair canal, × 23.

21. A thin horizontal section of a young ♀ receptacle, showing the archegonia in cross-section in groups alternating with the root-hair canals, × 38.

22. A young antheridium, free in its loculus, × 225.

23. A mature antheridium, with wall more or less blended with that of the loculus, × 53.

24–27. Receptacles with mature sporogonia, × 4; 24 and 25, lateral views, the former from alcoholic, the latter from dry material; 26 and 27, dorsal views, the latter from a pressed specimen and showing externally the position of the "costae"; 28, ventral view.

29. Capsule, apical view, showing operculum, × 23.

30 and 31. Vertical sections of capsules-wall, showing the bistratose operculum, × 27.

32. Spore, outer face, × 305.

33. Elater, × 305.

Figs. 1–3, 6–12, 16–24, 26, 28–31, from material collected at Fruit Vale, Alameda County, fixed at 1% chromic acid, and preserved in alcohol; 4 from Folsom (Mrs. Brandegee); 5, dry material, Fruit Vale; 13, 14, 32 and 33, dry material, Menlo Park (Mr. W. C. Blasdale); 15, Mexico (Humboldt); 27, Pasadena (McClatchie).

7. ASTERELLA Pal. de Beauv. *p. p.* Encyc. Meth. Bot. Suppl. 1: 502. 1810.

Fimbraria Nees, Hort. Phys. Berol. 44. 1820. [Afterward amended to *Fimbriaria.*]

Hypenantron Corda; Opiz, Beitr. 1: 648. 1829.* Schiffn.; Engler & Prantl, Nat. Pflanzenfam. 1^3: 33. 1893.

Thallus simple or somewhat sparingly dichotomous, sometimes innovating in front, or laterally from near the ventral aspect of the more or less distinctly defined costa, very thick, usually with a thin often colored margin, commonly dark purple beneath, pores and areolae of the dorsal surface distinct or somewhat obscure in drying, air chambers deep or rather small and shallow, scales mostly violet-purple, rarely white. Stomata of the thallus simple, the cells bounding the pore with unthickened radial walls; stomata of ♀ receptacle dolioform. Monoicous or less commonly dioicous. Antheridia in slightly elevated or indistinctly defined receptacles borne in the median line of the thallus or on short specialized lateral branches. ♀ receptacle obtusely conical or subhemispherical, sometimes depressed-umbonate or flattened with age, maturing 1–6 (usually 3 or 4) sporogonia, these enclosed singly in the strongly or obscurely defined lobes. Peduncle a direct continuation of the thallus or of a thallus-lobe, the latter sometimes a small innovation springing from one side of the median ventral line of the costa, the dorsal (posterior) face of the peduncle without assimilative tissue, the ventral (anterior) face with a single root-hair furrow, in communication with which at the apex are root-hair sinuses in the receptacle alternating with its lobes. Sporogonium and the commonly inconspicuous calyptra surrounded by a special membranous involucre, the pseudoperianth, this at first somewhat conical, becoming usually much exserted, finally with 3–18 longitudinal clefts, the narrow segments coherent at the apex or soon becoming free. Capsule globose, ovoid, or obovoid, more or less regularly circumscissile above the middle or (in *A. Californica*) the apical third or half of the wall falling away irregularly in dehiscence, leaving a fimbriate-lacerate margin, the wall—for the most part, at least—of a single layer of cells, without annular or spiral thickenings, but often exhibiting distinct trigones, especially in the apical portion. Seta very short, foot bulbous. Spores rather large, yellow, brown, fuscous, or black, obscurely tetrahedral or flattened, usually with a pellucid margin, areolate-reticulate, verrucose, or irregularly rugose. Elaters 1–4-spiral.

Key to the Species.

♀ branch from apex of thallus or of one of its main segments.

♀ receptacle strongly lobed, paleaceous-barbate beneath; segments of pseudoperianth coherent at apex; spores yellow, elaters mostly unispiral; dioicous. 1. *A. Californica.*

♀ receptacle conic-ovate, scarcely lobed, naked beneath; segments of pseudoperianth coherent at apex; spores fuscous or black, elaters 1–3-spiral; monoicous. 4. *A. Palmeri.*

* See foot-note under *Ricciocarpus*, p. 33.

♀ receptacle subhemispherical, obscurely lobed, naked beneath; segments of pseudoperianth soon free; spores yellow or light brown, elaters 2–4-spiral; monoicous. 5. *A. gracilis.*

♀ branch from apex of a small lateral innovation, the latter springing from the costa at one side of its median ventral line.

♀ receptacle subhemispherical or depressed-umbonate, 2–3.5 mm. in maximum width; pseudoperianth white, 10–12-cleft; spores 65–85 μ, elaters 8–10 μ broad. 2. *A. Boanderi*

♀ receptacle subconoidal, 2.5–5 mm. in maximum width; pseudoperianth commonly violet, 12–18-cleft; spores 60–125 μ, elaters 9–16 μ broad. 3. *A violacea.*

1. ASTERELLA CALIFORNICA (Hampe) Underw. Bot. Gaz. **20**: 60. 1895.

Fimbriaria Californica Hampe; Aust. Hep. Bor.-Am. 135. 1873. Underw. Bull. Ill. State Lab. Nat. Hist. **2**: 41. 1884.

Sauteria limbata * Aust. *p.p.* Proc. Acad. Nat. Sci. Philad. 1869: 229. 1869.

* Through the kindness of Professor F. E. Weiss of the Owens College, Manchester, England, we have enjoyed the privilege of being able to examine the original material upon which the *Sauteria limbata* of Austin was founded. We find, as does Count Solms-Laubach, who has also studied the type specimen (See Bull. Herb Boiss. **6**: 773. 1898), that Mr. Austin's diagnosis was drawn from two entirely distinct species, but we would differ from Count Solms as to the identity of the plant from which the first and greater part of Mr. Austin's description was made and from which the character embodied in the specific name was derived. This we find to be the ♂ thallus of the always dioicous *Asterella Californica*. We were assisted to this view by the discovery of an androecium, which apparently escaped the notice both of Mr. Austin and Count Solms. The antheridia were found to be united in a definitely circumscribed and slightly elevated area and to have short ostiolar papillae instead of being scattered and having slenderly subcylindrical ostiolar papillae as in *Sauteria* and *Clevea*. The ventral scales, stomata, dorsal epidermis, and internal structure were then compared with the corresponding parts of *Asterella Californica* and were found to agree so accurately as to remove all doubts of the specific identity of the two plants. And we could discover no evidence of admixture save with the fertile plant from which Mr. Austin drew the description of the ♀ receptacle and peduncle of his *Sauteria limbata*. This fertile plant we refer to our *Clevea hyalina Californica*. Count Solms, however (*fide* Stephani, *l. c.*) found the stomata of the "sterile" plant to conform to those of *Clevea hyalina*. We, on the other hand, found that the radial walls of the cells bounding the stomata were sometimes slightly thickened, but no more so than in *Asterella Californica* and never in any such way as in the typical stomata of the *Astroporae*. *Asterella Californica* was found growing at Ukiah in rather close association with our *Clevea hyalina Californica*.

Count Solms, in his MS. notes left with the type-material, retains the specific name *limbata* for the "sterile" [♂] plant, and it would seem to us that the name should be maintained for this plant if for either, inasmuch as the description of it occupies the first and by far the greater part of the original diagnosis and inasmuch as it was

Clev:a limbata Solms *p.p.*; Stephani, Bull. Herb. Boiss. 6: 773. 1898.

Thallus 8–25 mm. long, usually 1–3 times dichotomous, rarely simple, the ultimate segments emarginate, obovate, obcordate, or broadly oblong, indistinctly areolate, 4–12 mm. in maximum width, abruptly carinate, lightly concave above, sometimes narrowly canaliculate toward apex, 25–35 cells thick in axile parts, with rather large air-cavities, margins undulate-crenate, commonly broad, thin, and brownish-purple, ascending on drying, or occasionally erect and connivent, the reddish-purple scales subovate or ovate-lanceolate, not reaching to the margin or sometimes inconspicuously projecting and inflexed toward the apex, each with 1–4 slenderly acuminate or subfiliform, nearly entire, often decolorate, apical processes: dioicous: ♂ and ♀ plants mostly in separate patches; antheridia in clearly circumscribed, slightly elevated, strongly papillate, oval to linear-oblong, sometimes forked discs, situated in the median line of the thallus at some distance back of the apex: ♀ receptacle from the apex of the thallus, bearing 2 or 3 archegonia in each of the 4 or 5 groups, maturing 1–5 (commonly 4) sporogonia, large (4–7 mm. in maximum width), finally subhemispherical, convex-umbonate, nearly smooth above, containing large air-chambers and becoming vesicular-rugose in drying, paleaceous-barbate beneath, with strongly defined, rather turgid, often spreading, entire or crenate-margined lobes; peduncles stramineous, stout, 10–30 mm. × .5–.6 mm., naked or very sparingly pilose, without paleae at base, sulcate, angled, and slightly twisted when dry; pseudoperianth white, large, ovate, 12–16 cleft, the segments co-

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evidently the "broad, wavy, dark purple, membranaceous margin of the frond" of this that suggested the name. Others, however, might contend that the name should go with the more complete capsule-bearing plant. If retained for the former (the *Asterella*), it would appear to have four years priority over the name *Californica*, and would thus, in accordance with the Rochester Code, replace this latter name But the determination of sterile and even of antheridiiferous thalli of the Marchanticeae is sometimes a difficult and delicate matter, and it is to be feared that in this particular case the identity of the scanty material upon which "*Sauteria limbata*" was chiefly founded migl t always be more or less of a "bone of contention." The unsatisfactoriness of this material may be seen from the fact that while we identify it without hesitation with *Asterella Californica*, a botanist of the experience and high standing of Count Solms-Laubach refers it without reserve to the genus *Clevea*. Under these circumstances it seems to us the wiser course to leave aside altogether the name *limbata*

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Since the above note was written, Count Solms-Laubach, to whom we had sent a specimen of *Asterella Californica* for comparison, admits (Bot. Zeit 57[1]: 30. 16 F. 1899) that we have shown "ziemlich zweifellos" its identity with the sterile portion of the original "*Sauteria limbata*" material

hering at the rather obtuse apex, their margins plane or lightly reflexed; capsule prolate-ellipsoidal or subglobose, the apical third or half of its wall falling away irregularly in dehiscence leaving behind a cup with a fimbriate-lacerate margin; seta very short; spores yellow, 90–135 μ, obscurely tetrahedral, furnished when mature, especially at the angles and on the outer face, with conspicuous irregular ridges or wings, the entire surface minutely reticulate (meshes 1–5 μ); elaters 150–240 μ × 12–18 μ, obtuse, slightly flexuous, with one or, more rarely, two, yellow spiral bands.

Exsicc. Hep. Bor.-Am 135 (as *Fimbriaria Californica*).
Hep. Am. 119 (as *Fimbriaria Californica*).

On open or lightly shaded banks, often about rocks, from San Diego as far north, at least, as Mendocino and Shasta counties. Berkeley; San Leandro (Underwood); San Francisco (Bolander, Brandegee, Howe); Mill Valley; Duncan's Mills, Sonoma Co.; Ukiah and Half-Way House, Mendocino Co.; Oak Run, Shasta Co. (Baker & Nutting); Jackson, Amador Co. (Geo. Hansen); Murphy's, Calaveras Co. (J. Burtt Davy); Mt. Diablo, Contra Costa Co.; Knight's Landing, Stainslaus Co. (F. W. Bancroft); Fresno (F. P. Nutting); Kaweah River, Tulare Co. (Coville); Lake San Andreas, San Mateo Co.; Palo Alto (Campbell); Santa Cruz (Farlow); Santa Barbara (Farlow); Nordhoff, Ventura Co. (Miss Jacqueline K. Newton); Santa Monica (Dr. Hasse); Pasadena (Underwood, McClatchie, Miss Teed); Santa Ana Hills (Parish, no. 1728); Twin Oaks, San Diego Co. (F. W. Koch), San Diego (Farlow). First collected by Bolander and by Bigelow.

Somewhat resembling in size and habit *Asterella Lindenbergiana* Lindb. (*Fimbriaria Lindenbergiana* Corda), but very distinct in being dioicous, in the broader, obovate thallus-segments, in the more strongly lobed receptacle, the white pseudoperianth, the much larger, more prominently rugose-winged, more minutely reticulate, yellow spores, the yellow spiral band of the elaters, the irregular dehiscence of the capsule, etc.

PLATES 95 AND 96. ASTERELLA CALIFORNICA.

1. ♀ plant, natural size, with fully developed receptacle and peduncle.
2 and 3. Male plants, natural size.
4. A large sterile thallus, natural size.
5. ♀ plant with young receptacles, natural size.

6. Ventral view of thallus, natural size.

7. Outline of transverse section of ♂ thallus, near apex, × 23.

8. Outline of transverse section through androecium, × 23.

9. Outline of longitudinal section through androecium, × 12.

10. A very thin median longitudinal section of thallus, × 48.

11-13. Ventral scales, × 12.

14. Cross-section of young peduncle, × 41.

15. Cross-section of a mature peduncle, × 23.

16. Surface view of stoma from near thallus-apex, × 305.

17. Outline of portion of longitudinal section of thallus passing through a young receptacle, × 23.

18. Section of ♀ receptacle in a plane perpendicular to the peduncle, showing two archegonia in transverse section in each lobe, one of each group fertilized and surrounded by the developing pseudoperianth, × 23.

19–21. ♀ receptacles, the first young, the others with matured sporogonia, × 4.

22. Sectional view of a dolioform stoma from ♀ receptacle, × 225.

23. Outline of mature sporogonium, × 12.

24. Capsule after dehiscence, × 12.

25. Spore, outer face, × 225. (The folds and ridges of the epispore become sometimes more numerous than here represented.)

26. Spore, inner faces, × 225.

27. A portion of the wing-margin of spore, showing the minute reticulation, × 305.

28. Sections of fully matured spores, showing the great development of the episporic layer, × 225. The section on the left passes considerably to one side of the center of the spore and consequently gives a somewhat exaggerated idea of the thickness of epispore in comparison with the width of the lumen.

29. Elaters, × 225.

Figs. 11–13 drawn from material collected by Mr. J. Burtt Davy in Calaveras County; 25–27, and 29, from Oak Run, Shasta County (M. S. Baker and F. P. Nutting); the remaining from specimens collected by the author in Mill Valley and near Berkeley.

2. ASTERELLA BOLANDERI (Aust.) Underw. Bot. Gaz. **20**: 61. 1895.

Fimbriaria Bolanderi Aust. Proc. Acad. Nat. Sci. Philad. 1869: 230. 1869.

Aromatic: thallus oblong to narrowly linear, 10–45 mm. × 1.5–4 mm., costate-carinate, 25–35 cells thick in the middle, becoming very thin at the usually desiccated border, innovating in front or laterally from the costa, very rarely dichotomous, indistinctly porose, scarcely areolate, light green above, usually purple below, rounded or very slightly emarginate at the apex, nearly flat or lightly concave when living, the membranous, undulate-crenate, brown or purple margins often erect and appressed-connivent on drying, air-cavities small, scales dark purple, not reaching the margin, the costa densely clothed with matted root-

hairs: monoicous: androecia and ♀ branches on short lateral innovations, the latter 1.5–3 mm. in length, springing from the sides of the costa, those bearing a ♀ branch expanded, emarginate, bilobed, or somewhat obcordate, 1–3 mm. in maximum width, those bearing the androecia subclavate, only slightly expanded at the distal extremity, .75–1 mm. in greatest width, all furnished beneath with scales and root-hairs: ♂ receptacles with 4–10 antheridia, lightly papillate: ♀ receptacle with a single archegonium in each of the 4 lobes, maturing, commonly, 3 or 4-sporogonia, subhemispherical at first, becoming subconical, depressed-umbonate, or muc hflattened, with lobes somewhat divergent, 2–3.5 mm. in maximum width, containing small air-chambers, rugose on drying, surrounded and more or less covered, when young and sessile, with narrow paleae, these springing mostly from its ventral surface or from the top of the peduncle, inconspicuous at maturity; peduncle slender, 10–25 mm. × .25–.55 mm., brownish-purple below, pale above, sparingly pilose toward the base, apex of the innovation often with a few inflexed scales; pseudoperianth white, conical and acute when young, finally subglobose, with 10–12 widely gaping clefts, the segments cohering at the apex, rarely free with age, mostly with revolute margins: capsule subglobose, sometimes oblately flattened, nearly black at first, becoming brown, circumscissile somewhat above the middle, the margin irregularly toothed; spores obscurely tetrahedral, 65–85 μ, yellowish-brown, becoming darker, alveolate-areolate, with 4–6 areolae across each face, the angles of the spore with a yellow pellucid margin; elaters 200–250 μ × 8–10 μ, closely 2-(3-) spiral.

Exsicc. Hep. Bor.-Am. 136d (as *Fimbriaria Bolanderi*).
Hep. Am. 158 (as *Fimbriaria Bolanderi*).

On lightly shaded banks. Fruit Vale, Alameda Co. (Miss Edith S. Byxbee); Mill Valley, Marin Co. (Howe); Hood's Peak, Sonoma Co. (F. T. Bioletti); Howell Mountain, Napa Co. (W. A. Setchell); Jackson, Amador Co. (Geo. Hansen); Twin Oaks, San Diego Co. (F. W. Koch). The species was originally collected at San Rafael by Dr. Bolander in 1865; it was also found by Dr. Bolander in the same year in dry ditches near the American River at Auburn.

The lateral innovations in this species show a tendency to group in such a way that nearly all on one side of the thallus bear antheridial discs and nearly all on the other side ♀ branches. In the San Diego County specimen the elaters are sometimes unispiral.

PLATE 97. ASTERELLA BOLANDERI.

1. Plant, natural size.
2. A sterile thallus, natural size, somewhat unusually elongated.
3. Thallus, branching by latero-ventral innovations, × 3.
4. Thallus with the small ♂ and ♀ latero ventral innovations and an apical vegetative innovation, × 3.
5. Receptacle with mature sporogonia, × 4 (from alcoholic material).
6. Young receptacle × 4 (alcoholic).
7. Mature receptacle (dry), × 4.
8. Mature receptacle (dry), × 8.
9. Longitudinal section of thallus a little one side of the median line, showing insertion of the ♂ and ♀ innovations, × 23.
10. Median longitudinal section of the thallus, × 47.
11. Transverse section of the thallus, with androecium, × 23.
12. Innovation with young ♀ receptacle, × 8.
13. Innovation bearing androceium, × 8.
14. Stoma, surface view, × 225.
15. Longitudinal section of innovation with young ♀ receptacle, × 23.
16. Portion of transverse section of thallus with longitudinal section of a ♂ branch, × 41.
17. Transverse section of one of the innovations near the base, × 41.
18. Cross-section of peduncle, × 41.
19. Sporogonium, × 12.
20. Capsule after dehiscence, × 12.
21. Spores, × 225.
22. Elater, × 225.

The figures are drawn, for the most part, from specimens collected in Mill Valley, Marin County.

3. ASTERELLA VIOLACEA (Aust.) Underw. Bot. Gaz. **20**: 61. 1895.
Fimbriaria violacea Aust. Bull. Torr. Bot. Club, **3**: 17. 1872.

Aromatic: thallus oblong to narrowly linear, 8–25 mm. × 1.5–5 mm., broadly costate-carinate, 30–40 cells thick in median parts, becoming very thin at the border, innovating in front, or more often, laterally, from the costa, sometimes dichotomous, obscurely areolate, indistinctly porose, rounded or slightly emarginate at the apex, densely radiculose along the costa, concave or canaliculate above when moist, the usually broad brownish membranous undulate-crenate margins commonly erect and appressed-connivent on drying, air-chambers small, scales dark purple, sometimes reaching the margin: monoicous: androecia and ♀ branches borne on short innovations, the latter springing from the sides of the costa near the median ventral line, 1.5–4 mm. long, those bearing a ♀ branch bilobed, obcordate, or emarginate-subquadrate, 2–4 mm. in maximum width, those bearing an androecium clavate, slightly expanded at apex, .75–1 mm. in maximum

width: androecia with 6–12 antheridia, lightly papillate: ♀ receptacle enclosing a single archegonium in each of the four lobes, maturing 2–4 (usually 3) sporogonia, subconoidal with lobes directed downward or only slightly spreading, very rarely becoming depressed-umbonate, 2.5–5 mm. in maximum width, containing small air-chambers, nearly smooth, or, on drying, subrugose, densely surrounded when young and sessile by narrow paleae springing from its ventral surface or from the upper part of the peduncle, these usually persistent and conspicuous at maturity; peduncle 10–40 mm. × .35–.55 mm., brownish-purple, becoming abruptly pale near the receptacle, pilose toward the base; pseudoperianth commonly violet, conical, finally obovoid-subpyriform, or subglobose, with 12–18 narrow or somewhat gaping clefts, the segments cohering at the apex or often becoming free with age, sometimes flexuous and contorted, the margins commonly revolute: capsule nearly spherical, the apical third or half of its wall falling away in dehiscence in irregular fragments, leaving a subhemispherical cup with an erose-dentate margin; spores yellow, becoming brownish, 60–125 μ, alveolate-areolate, with 4–7 areolae across each face, the pellucid margins finally broad; elaters 180–320 μ × 9–16 μ, closely 2- or 3-spiral, the bands yellow or slightly brown.

On exposed or somewhat shaded banks. Olema, Marin Co. (Jepson); St. Helena, Napa Co. (Jepson); Ukiah, Mendocino Co. (Howe); Oak Run, Shasta Co. (Baker and Nutting); Jackson, Amador Co. (Hansen); Pasadena (McClatchie, Feb. 18, 1893—mixed with *A. Palmeri*). Collected also by Coulter and by Bolander, the precise locality unknown. Not known to occur outside of California.

Asterella violacea seems occasionally to approach *A. Bolanderi*, but is usually very distinct in the violet 12–18-cleft pseudoperianth, the larger more conical ♀ receptacle with less spreading lobes and more abundantly paleaceous-barbate beneath, and in the commonly larger spores and broader elaters. The violet coloration sometimes disappears from the pseudoperianth, but in such cases a trace of purple is often to be detected on the outer involucre near its margin.

PLATE 98. ASTERELLA VIOLACEA.

1. Plant, natural size.
2. Thallus, showing branching and the ♂ and ♀ innovations, × 3.
3. Thallus, natural size, with the somewhat unusual dichotomous branching.

4–6. ♀ receptacles with matured sporogonia, × 4.

7–8. Transverse sections of thallus, showing in the latter a ♂ innovation, × 23.

9. Transverse section of peduncle, × 41.

10. Capsule in dehiscence, × 12.

11. Capsule after dehiscence, × 12.

12. Elater, × 225.

13. Spore, outer face, × 225. (The walls of the areolae appear somewhat too rigid.)

Figures all from soaked-out dried material; 1–3, 5, and 7–9 from specimens collected by Mr. Geo. Hansen near Jackson, Amador Co.; 4, St. Helena (Mr. W. L. Jepson), 6, Olema, Marin Co. (Jepson).

4. ASTERELLA PALMERI (Aust.) Underw. Bot. Gaz. **20**: 63. 1895.

Fimbriaria Palmeri Aust. Bull. Torr. Bot. Club, **6**: 47. 1875. Steph. Bull. Herb. Boiss. **7**: 213. 1899.

Fimbriaria nudata M. A. Howe, Erythea, **1**: 112. 1893. Steph. Bull. Herb. Boiss. **7**: 212. 1899.

Asterella nudata Underw. Bot. Gaz. **20**: 61. 1895.

Thallus simple or once dichotomous, 5–10 mm. long, 2–5 mm. in maximum width, the segments or entire thallus obcordate to obcuneate, rather indistinctly areolate above, dark purple beneath, broadly carinate, 30–40 cells thick in median parts, with numerous and deep air-chambers, the brown or purple, usually broad, undulate-crenate margins ascending, commonly appressed-connivent on drying, scales dark purple, very rarely decolorate, often extending slightly beyond the margin, a few sometimes inconspicuously inflexed at the apical sinus: monoicous: antheridia occupying a lightly elevated oval or oblong, papillate area just posterior to the base of the ♀ branch: receptacle maturing 2–6 (commonly 3 or 4) sporogonia, becoming obtusely conic-ovoid, scarcely lobed, sometimes constricted near the middle in drying, 2.5–4 mm. in maximum width, nearly smooth or subrugose when dry, naked beneath, air-chambers large; peduncle from apex of the thallus, light brown or stramineous, 12–40 mm. (mostly 15–20 mm.) × .35–.65 mm., naked, without involucre at base, sulcate, rather brittle; pseudoperianth white, the exserted portion globose-ovoid, often strongly constricted at zone of emergence, with 8–12 narrow or somewhat gaping clefts, the segments coherent at the apex: capsule nearly spherical, irregularly circumscissile above the middle; spores 60–80 μ, at first almost colorless, marked only with faint ridges or lines, at maturity very opaque, fuscous or black, with a rather narrow warty border, the faces irregularly rugose-areolate; elaters 1–3-(mostly 2-) spiral, 120–270 μ × 10–18 μ, sometimes branched, finally yellowish-brown.

Mill Valley (Howe), St. Helena (Jepson), Jackson (Hansen), Pasadena (McClatchie), San Bernardino (Parish), Santa Monica (Hasse); also at San Diego by an unknown collector and at Witch Creek, (San Diego Co. ?) (R. D. Alderson).

The original specimens were collected by Dr. Palmer on Guadalupe Island, off the coast of Lower California. Portions of what appear to be the original plants are found in herb. Underwood and herb. Columbia University.

Asterella fragrans (Schleich.) Trevis.—to which *A. Palmeri* is probably most nearly allied—has been found in New Mexico, Idaho and Alaska, and is likely to occur in California. This differs from *Asterella Palmeri* in the conspicuous white scales projecting beyond the margin of the thallus, in the presence of an involucre of narrow whitish paleae at the base of the peduncle, in the yellow, more broadly margined spores, etc. The spores of *Asterella Palmeri* show a tendency to cohere in large masses until very late in the process of ripening—a character which seems also to be exhibited by *A. fragrans.*

PLATE 99.

1-15. *Asterella Palmeri.*

1. Plant, natural size.

2. Thallus, showing peduncle and position of androecium, × 3.

3. Transverse section of thallus through androecium, × 23.

4. Median longitudinal section of thallus, passing through androecium and base of peduncle, × 23.

5 and 6. Fully developed ♀ receptacles, dry, × 4.

7-10. Series of cross-sections of peduncle fom near apex to base, × 41.

11. Capsule in dehiscence, × 12.

12. Elater, × 225.

13. Young spore, × 225.

14. Mature spore, × 225.

15. Section of mature spore, × 225.

Figs. 1, 2, 6, 12 and 13 drawn from Guadalupe Island material (legit Palmer); 3-5, 7-10 and 15, St. Helena (Jepson); 11 and 14, Jackson, Amador Co. (Hansen).

5. ASTERELLA GRACILIS (Web. *f.*) Underw. Bot. Gaz. **20**: 61. 1895.

Marchantia gracilis Web. *f.* Hist. Musc. Hep. Prod. 105. 1815.

Marchantia pilosa Wahl. Fl. Lapp. 399. 1812. Not *M. pilosa* Horn. Fl. Dan. **8**: 7. *pl. 1426.* 1810.

Marchantia Ludwigii Schwaegr. (?) Hist. Musc. Hep. Prod. 33. 1814.

Fimbriaria gracilis Lindb. Not. ur Sällsk. pro Fauna et Flora Fenn. 9: 282. 1868.

Thallus simple or once dichotomous, linear-obcuneate, sometimes oblong or obovate, 4–10 mm. × 1.5–3 mm., rather distinctly porose and areolate, canaliculate or somewhat broadly concave, dark purple underneath, 25–35 cells thick in median parts, with deep air-chambers, the narrow, purple or concolorous, undulate-crenate margins ascending, or, on drying, sometimes erect and connivent, scales purple, reaching the margin or now and then projecting a little beyond: monoicous: antheridia few, immersed in the thallus just posterior to the base of the ♀ branch, loculi with papilliform ostioles: ♀ receptacles maturing 1–4 (mostly 3) sporogonia, subhemispherical, 1.5–3 mm. in diameter, nearly smooth, becoming rugose in drying, naked beneath, the obscurely defined lobes with a thin membranous border; peduncle from the apex of the thallus, 10–40 mm. × .3–.5 mm., light brown to brownish-purple, naked, surrounded at the base by a few, often inconspicuous scales or paleae; pseudoperianth white, 5–12- (mostly 8-) cleft, the segments early becoming free, most frequently somewhat inclined together, sometimes spreading: capsule quite regularly circumscissile above the middle; spores yellow or slightly brown, 48–64 μ, narrowly margined, areolate-reticulate or with shallow alveolae, the meshes 5–8 across each face, with somewhat thickened walls and angles; elaters 150–275 μ × 7–15 μ, 2–4-spiral, more or less attenuate at the ends, commonly flexuous or contorted, sometimes branched.

Near Mineral King, Tulare Co. (Coville and Funston, Death Valley Expedition, nos. 1420 and 1510, August 1891).

8. CONOCEPHALUM* Wigg. Prim. Fl. Hols. 82. 1780.

Fegatella Raddi, Opusc. scientif. di Bologna, 2: 356. 1818.†

Thallus large, dichotomously branched, with long root-hairs springing in tufts from the narrow clearly defined costa, areolae very distinct, mostly hexagonal, stomata simple (except on ♂ and ♀ receptacles), large, forming whitish pustule-like elevations, the pores easily visible to the unaided eye; chlorophyll-bearing

* We have been unable to verify this citation. A transcription of Wiggers' diagnosis is given by M. Auguste Le Jolis (Mém. Soc. nation. Sci. nat. et math. Cherbourg 29: 125. 1894).

† See footnote under *Reboulia*.

stratum thin, the uppermost cells in the air-chambers with a conical or long-cylindrical colorless rostrum; costa clothed with closely imbricate scales, those at the apex often with a violet orbicular or reniform apical expansion, marginal scales absent. Gemmae-cups wanting. Androecium disciform, strongly papillate, sessile in a depression bounded by a somewhat scarious-membranous elevation of the dorsal layers of the thallus, terminating a short branch, this becoming apparently lateral by the continued growth of the other fork. ♀ receptacle obtusely conical, indistinctly or not at all lobed, long-stalked, surrounded when still sessile by a slightly elevated membranous sheath; peduncle with a single root-hair furrow, its dorsal (posterior) surface destitute of assimilative tissue. Involucres 4–11, tubular, confluent, constituting almost the whole of the matured receptacle, each surrounding a single sporogonium. Pseudoperianth wanting. Capsule oblong-pyriform, on a thick pedicel mostly a little more than one half as long, dehiscing by cleavage about to the middle into 4–8 recurved irregular valves, its final exsertion usually accompanied by the detachment of the pedicel from the receptacle, capsule-wall of mainly a single layer of thick cells with annular and spiral thickenings; spores large, papillate, multicellular at time of dehiscence; elaters rather short and thick, 2–4-spiral.

1. CONOCEPHALUM CONICUM (L.) Dumort. [as *Conocephalus*] Comm. Bot. 115. 1822. Underw. Bot. Gaz. **20**: 67. 1895.

Marchantia conica L. Sp. Pl. 1138. 1753.

Fegatella conica Corda; Opiz, Beitr. **1**: 649. 1829.*

Thallus oblong or linear, 5–25 cm. × .75–1.5 cm.; colorless stratum in region of the costa of 20–25 layers of small thick-angled cells, enclosing 3–5 large longitudinal (finally empty) mucilage canals and passing abruptly at the sides into 7–4 layers of larger cells, becoming bi- (rarely uni-) stratose at the extreme margin: dioicous: peduncle 3–6 cm. high, naked: spores yellowish-brown, 66–95 μ; elaters 200–270 × 9–30 μ, often dilated in the middle.

In moist deeply shaded places, especially on stones and rocks beside streams.

Felton, Santa Cruz Co. (Underwood); on stones in stream-bed near Lake Pilarcitos, San Mateo Co.; on moist ground in woods, "Big River Boom," near Mendocino; and on shaded dripping rocks near Eureka. Not common in California; first collected by Professor Underwood in 1888.

* See footnote under *Ricciocarpus*, p. 33.

None of the Californian specimens seen bear ♀ receptacles. The measurements of spores and elaters have been taken from a plant collected near Seattle, Washington, by C. V. Piper.

Conocephalum in a sterile state may be readily distinguished from *Marchantia polymorpha* by the usually longer thallus, the very distinct mostly hexagonal areolae, the simple (not "compound" or "dolioform") stomata with pores easily visible to the unaided eye, the conical or elongate-cylindrical rostrum of the upper green cells in the air-chambers, the absence of marginal scales, the narrow clearly defined costa, etc.

9. LUNULARIA Adans. Fam. Pl. 15. 1763. Ex Mich. Nov. Pl. Gen. 4. *pl.* 4. 1729.

Thallus moderately large, furcate or often progressing by innovations from the apex, with an effuse median thickening, the segments oblong or obcuneate, with a hyaline unistratose margin 1–4 cells in width, areolae mostly indistinct after drying; stomata simple, the pores invisible to the unaided eye, the surrounding elevated cells, however, often whitish and readily visible; chlorophyll-bearing stratum narrow in a sectional view, occasional cells of the colorless layer containing a large oil-body in the form of an emulsion. Gemmae in crescentic receptacles, the thin entire margin of the latter wanting in front. Dioicous (sometimes monoicous?). Androecium sessile, oval-disciform, papillate, surrounded by a slight elevation of the adjacent parts. ♀ receptacle arising from a deep sinus of the thallus, surrounded when young and sessile by a tubular-ovate sheath, consisting of numerous scales, the inner of these membranous, hyaline, ciliate-fimbriate; archegonia in commonly four groups of three or four, only one in each group developing a sporogonium; receptacle destitute of stomata and root-hairs, consisting at maturity almost wholly of the slightly thickened top of the peduncle and of the 1–6 (usually 4) spreading tubular involucres each surrounding a single sporogonium. Pseudoperianth wanting. Peduncle without a root-hair furrow, delicate, pellucid, pilose, involucrate at base. Capsule dark-brown, obovoid, rather long-stalked, exserted from the bilabiate or repand-mouthed involucre, quadrivalved to the base in dehiscence, the valves often 2-parted, more or less twisted in drying, the cells of the wall without annular or spiral thickenings. Spores yellow or brownish, smooth. Elaters bispiral, very long and slender, often adhering a long time to the ends of the valves.

Only one species of the genus is ordinarily recognized:

1. LUNULARIA CRUCIATA (L.) Dumort. Comm. Bot. 116. 1822.

Marchantia cruciata L. Sp. Pl. 1137. 1753.

Thallus 1–5 cm. × .5–1 cm., colorless layer about 20 cells thick along the axis, becoming gradually thinner to the unistratose margin: peduncle 1.5–3 cm. high: spores 15–18 μ; elaters 300–650 μ long, 5–6 μ broad in the middle.

In and about greenhouses. Oakland, San José, and San Francisco (Underwood, 1888); Berkeley and San Francisco (Howe); also in the Golden Gate Park, San Francisco, at considerable distance from any greenhouse; Pasadena (*fide* McClatchie). Introduced from Europe. Only a sterile gemmiferous condition is known to occur in America, but the plant is easily recognizable by the crescentic, entire-margined gemmae-cups, which are almost always present. Our diagnosis has been completed from European material and from the descriptions of authors.

10. MARCHANTIA L. Sp. Pl. 1137. 1753.

Ex March. *fil.* Act. Ac. Paris. 229. 1713.*

Thallus large, usually several times dichotomous, with a broad effuse costa, the root-hairs abundant, areolae mostly rhombic, stomata dolioform throughout, often not readily visible to the unaided eye; air-chamber stratum sharply defined against the underlying colorless tissue, of a single layer of caverns, these filled with branched, chlorophyll-bearing filaments. Gemmae in cup-shaped, dentate-margined receptacles arising from the dorsal surface of the costa. Androecium long-stalked, disciform, with a thin crenate margin or stellately or palmately lobed, furnished with scales on the ventral surface. ♀ receptacle stellate or rarely subentire, usually somewhat eccentric, with 4–11 often much elongated and finger-like, deflexed or spreading rays, each of the latter containing a single root-hair canal communicating with its ventral surface or, at distal extremity, wholly enclosed. Peduncle with two (very rarely three) root-hair furrows, provided on its dorsal (posterior) surface with stomata and an air-chamber layer.† Archegonia commonly in 8 groups of several each (sometimes in 4 groups, occasionally in other numbers by suppression, abortion,

* Citation from Pfeiffer, Nomenclator Botanicus.

† This, in effect, is asserted of the genus *Marchantia* by Stephani (Bot Gaz. 17: 60 1892. Bull. Herb. Boiss. 7: 384. 1899). Most of the numerous species of *Marchantia* are exotic and we are unable to assert from any personal investigations that this character belongs to all. It certainly holds good for *M. polymorpha*.

or irregular multiplication) alternating * with the rays, these, however, one in excess of the archegonia-groups. Each group of archegonia usually maturing several sporogonia, these enclosed by a common membranous 2-valved, fimbriate involucre, and each surrounded by a cleft pseudoperianth. Capsule borne on a seta as long as the pseudoperianth, dehiscing by several revoluble teeth or short valves. Spores small, smooth or nearly so. Elaters long and narrow, 2-(1–3-) spiral.

1. MARCHANTIA POLYMORPHA L. Sp. Pl. 1137. 1753.

Thallus prostrate or ascending, rarely suberect, often in widely extended masses, oblong or linear, 2–10 cm. × .5–2 cm., commonly several times dichotomous, about 16 cells thick in the middle of the costa, becoming gradually thinner to the narrowly unistratose, mostly somewhat undulate-crisped or irregularly short-lobed margin, areolae mainly rhombic, the pores scarcely visible to the unaided eye; the outer ventral scales oblong, obtuse, slightly exceeding the margin, colorless or tinged with brown or purple: dioicious: androecium peltate, with commonly 8 short rounded lobes or merely crenate: ♀ receptacle with 8–11 (commonly 9) finger-like, usually decurved rays; involucre fimbriate, its segments subulate-acuminate and ciliate-laciniolate, often rufous; peduncle of ♀ receptacle 2–7 cm. long, more or less pilose, that of the androecium usually shorter: capsule finally exserted, its wall unistratose, with annular thickenings; seta attaining length of 1–1.5 mm.; spores yellow, 12–15 μ, nearly smooth; elaters 300–600 μ long, attenuate, 3–5 μ in greatest width, bispiral.

On wet banks, in bogs, beside streams, about greenhouses, etc.

Widely distributed in California but hardly common. We can name only the following localities: Berkeley; San Francisco; Mill Valley, Olema; near Duncan's Mills, Sonoma Co.; Mendocino (577); near Eureka; near Douglas City (1161), Trinity Co.; Sisson; near Redding (Baker and Nutting); Silver Lake, Alpine Co. (Geo. Hansen); Jackson, Amador Co. (Geo. Hansen); San Bernardino Mts. (S. B. Parish, nos. 1445, 1446, 1693, 1694, 3369); vicinity of Pasadena (A. J. McClatchie). Also collected in California by Dr. Bolander. We have found no mature capsules in any Californian specimens and our description has been supplemented from material collected in Europe and in the eastern portions of the United States.

* Exc. *M. geminata* N. R. & Bl. See Schiffner, Ueber exotische Hepaticae, Nova Acta Ksl. Leop.-Carol. Deutsch. Akad. Naturforsch. 60: 280, 281. 1893.

Marchantia Oregonensis was described by Herr Stephani in 1891 (Bot. Centralb. **45**: 203) from ♂ plants collected by Röll on Mt. Hood. The only distinctive character emphasized is a reniform irregularly dentate and spinose appendage to the postical scales. In a portion of the original plant communicated by Herr Stephani to Professor Underwood, we have been able to detect a few such scales immediately bounding the costa at the apical sinus, but there are also oblong or linguiform, obtuse, entire scales toward the margin as in *M. polymorpha;* as we have observed quite similarly appendaged scales at the apex of the costa in European specimens of *M. polymorpha* (*e. g.*, Rab. Hep. Eur., no. 6; Massal. Hep. It. Ven. Exs., no. 21) and also in American specimens, we believe that this peculiarity has no specific significance. These appendages are usually of a violet or brownish color and are formed by a more or less pronounced narrowing of the scale accompanied by a slight twisting or convolution in the zone of contraction.

Order II. JUNGERMANNIALES.

Gametophore varying in different genera from a wholly leafless thallus, with or without a midrib but without other differentiation of tissues, to a cylindrical leaf-bearing stem. Root-hairs always with smooth walls. Stomata wanting. Sexual organs usually in groups, often on more or less modified branches, yet never on special stalked receptacles, rarely immersed.

The first division of the fertilized egg transverse, the lower of the two cells usually taking no further part in the development of the embryo.* Sporogonium provided with foot and seta, the latter commonly much elongated; calyptra ruptured. Capsule nearly always opening by four valves. Sterile cells always accompanying the spores, usually developed as elaters.†

The order Jungermanniales comprises the two somewhat artificial families, the Metzgeriaceae (see below) and the Jungermanniaceae (see page 82).

*See Campbell, The Structure and Development of the Mosses and Ferns, 72. 1895.

† Among the Californian genera, the sterile cells in *Sphaerocarpus* (which has several points of contact with the Ricciaceae) may be easily overlooked unless the contents of somewhat immature capsules are studied. The sterile cells are here starch-laden, are destitute of spiral thickenings and become disorganized or inconspicuous by the time he spores are fully ripe.

Family III. METZGERIACEAE.*

Apical cell of the gametophore never directly transformed into an archegonium. Sporogonia arising from the dorsal surface of the gametophore or only apparently from an apex. This family contains all the *Jungermanniales* in which the gametophore is persistently thallose and also the forms transitional between the thallophytic and cormophytic types. The aberrant genera *Haplomitrium* and *Calobryum* do not occur, so far as is known, on the North American continent. The involucres of the sexual organs and of the sporogonium very rarely, if ever, represent true leaves.

KEY TO THE GENERA OF METZGERIACEAE

Seta very short, less than $\frac{1}{10}$ mm. long; spores accompanied by sterile cells without spiral thickenings.

♀ gametophore suborbicular, the somewhat leaf-like peripheral lobes almost entirely concealed by the numerous subglobose, cylindrical-ovoid, or fusiform-clavate involucres; annual 11. *Sphaerocarpus.*

Gametophore a somewhat elongated thickened axis, with conspicuous crowded irregularly succubous foliar expansions on either side; perennial through the conversion of a large portion of the axis into a tuber. 12. *Geothallus.*

Seta 4–50 mm. long; elaters always developed.

Gametophore with quite clearly defined stem and leaves; root-hairs very long, mostly violet or vinous-purple. 16. *Fossombronia.*

Gametophore thalloid, without ventral scales and without special gemmae-receptacles.

Thallus rather fleshy, pinnately, palmately, or subdichotomously branched, the unistratose marginal lamina, if present, narrow and passing gradually into the costa; antheridia and archegonia on short lateral branches; spores unicellular. 13. *Riccardia.*†

Thallus irregularly dichotomous, the wide unistratose margin passing gradually into the indistinct costa; antheridia in loculi on the back of the costa, archegonia in a cavity near its apex; spores multicellular at time of dehiscence. 14. *Pellia.*†

Thallus with a narrow costa sharply limited from the unistratose marginal laminae, mostly dichotomous; antheridia and archegonia on short ventral branches. *Metzgeria* (p. 75).

Gametophore thalloid, but the thin margin often with more or less leaf-like lobes; cavities near the bases of the lobes commonly occupied by *Nostoc* colonies; ventral surface bearing small dentate scales; gemmae in long-necked, flask-shaped receptacles arising from the dorsal surface near the ends of the lobes; spores unicellular. 15. *Blasia.*

* Underwood, Bot Gaz 19: 361, 1894. The "Jungermanniaceae anakrogynae" of Leitgeb and of Schiffner.

† Sterile conditions of *Riccardia pinguis* and *Pellia* sp. may be easily confused. See remarks under *R. pinguis*.

11. SPHAEROCARPUS* Adans. Fam. Pl. 2: 14. 1763. Ex Mich. Nov. Pl. Gen. 4. *pl. 3.* 1729.

Gametophore small, orbicular, oblong, or cuneate, thallus-like and irregularly lobed or now and then subfoliose, of a few layers of nearly similar cells in central or median parts, the lobes unistratose unless at base, ascending or flat; root-hairs smooth, colorless, long and numerous. Dioicous. Sexual organs in most cases numerous and thickly covering the dorsal surface of the thallus, surrounded singly, rarely in groups of 2 or 3 (*fide* Leitgeb†), by unistratose involucres. ♂ plants much smaller than the ♀, scarcely visible to the unaided eye, commonly tinged with purple, oblong or cuneate, often once dichotomous or subpalmately lobed. Antheridia oval, on very short stalks, the involucres flask-shaped or subconical. Archegonial involucres usually crowded and more or less completely concealing the thallus, from tubular or clavate to pyriform or subglobose, orifice reduced to a small apical pore, this often enlarged at maturity. Calyptra of 2 or 3 layers of cells, usually ruptured early, the upper portion, with the archegonium neck, long persisting on the apex of the capsule.

Sporogonium consisting of a nearly spherical capsule, a very short or almost obsolete seta, and a well-developed foot. Capsule indehiscent, its wall of a single layer of cells destitute of spiral, annular, or other local thickenings. Spores permanently adherent in 4's, or (*S. Donnellii* Aust.) becoming free at full maturity, or (*S. cristatus* M. A. Howe) separating early in the development of the sporogonium; tetrads, when persistent, distinctly areolate, appearing crenulate, papillate, or subechinulate in optical section; spores, when separating, compressed-tetrahedral, rounded-

* Mr. James Britten (Journal of Botany, 36: 397–399. 1898) has recently called attention to the use in 1759 and 1763 of *Sphaerocarpus* as a name for the cruciferous genus commonly known as *Neslia*. The name is said to occur in both the first and second editions of Fabricius' "Enumeratio Plantarum Horti Helmstadiensis," published at the dates mentioned, respectively. In the first edition, which alone has clear priority over Adanson's work, "*Sphaerocarpus* Heister" appears simply as a synonym of "Rapistrum arvense fo io auriculato T." It would seem that the usual interpretation of the Rochester Code [the interpretation which denies the publication of *Dalea* as a genus in the Species Plantarum of Linnaeus (1753)] must be unable to recognize the publication of *Sphaerocarpus* as a genus in the above use of the word in the first edition of Fabricius' "Enumeratio." In any event, it would be a gross violation of the spirit of the priority principle to annul the original *Sphaerocarpus* of Micheli, grandly described and figured in 1729, in order to validate the application thirty years later of the same name to a totally different genus.

†Leitgeb, Untersuchungen über die Lebermoose, 4: 67, 68. 1879.

lenticular, or sometimes concavo-convex, areolate or cristate, in *S. Donnellii* prominently tuberculate-papillate in the basilar circumference. Accompanying the spore-mother-cells are smaller starch-bearing sterile cells probably equivalent to elaters morphologically, but lacking a spiral band, these more or less shriveled and obscure at the maturity of the spores.

Key to the Species.

Spores permanently united in tetrads, the surface of these regularly areolate; ♀ involucre 1.2–2.6 mm. high, oblong-cylindrical, fusiform-clavate, or very rarely subpyriform, more or less pointed at the apex, cells near the middle 90–150 $\mu \times$ 30–50 μ.
S. Californicus.

Spores separating long before the maturity of the capsule, their surface typically cristate, less commonly irregularly and sparingly areolate; ♀ involucre .85–1.2 mm. high, subglobose or obovoid, rounded at the apex, cells near the middle 45–80 $\mu \times$ 30–40 μ.
S. cristatus.

1. SPHAEROCARPUS CALIFORNICUS Aust. Bull. Torr. Bot. Club, **6**: 305. 1879.

Sphaerocarpus Berteri Aust. *p. p.* Hep. Bor.-Am. 138. 1873. Not Mont. Ann. Sci. Nat. Bot. II., **9**: 39. 1838.

Sphaerocarpus Michelii Bell., var. *Californicus* Aust.; Underw. Bull. Ill. State Lab. Nat. Hist. **2**: 30. 1884.

Sphaerocarpus terrestris Mich., var. *Californicus* Underw. Zoe, **1**: 364. 1890.

♀ thallus suborbicular, somewhat stipitate, mostly 4–8 mm. in diameter, commonly in thickly gregarious masses, the often leaf-like lobes almost entirely concealed by the involucres, these 1.2–2.6 mm. high, oblong-cylindrical, fusiform-clavate, very rarely subpyriform, sessile, more or less acuminate, the orifice usually inconspicuous; marginal cells of the thallus about 45 μ, medial surface cells 60–90 μ, cells near mouth of ♀ involucre 45–60 μ, near the middle, 90–150 $\mu \times$ 30–50 μ: ♂ thallus oblong, commonly furcate or subpalmately parted, the flask-shaped antheridial involucres .27–.36 mm. high: capsule .5–.7 mm. in diameter, seta scarcely perceptible at maturity, the foot commonly remaining in thallus when the capsule is detached; spores permanently united in tetrads, these 105–140 μ (mostly 120 μ) in diameter, dark brown, areolate, the meshes almost regularly pentagonal or hexagonal or somewhat elongated, 15–30 μ in diameter, the tetrad appearing crenulate or slightly papillate in optical section owing to the somewhat increased elevation of the ridges at the angles of the meshes, the entire surface very minutely granulate; sterile cells subspherical to irregularly oblong-cylindrical, 30–60 μ in longest diameter, evanescent at maturity of the spores.

Exsicc. Hep. Bor.-Am. 138 (*p. p.*).

On flat compact soil in meadows and besides paths, less commonly on moist banks. Berkeley; San Francisco; Mill Valley; Stanford University (Campbell), Reche Cañon, vicinity of San Bernardino (Parish, no. 3613); Pasadena (McClatchie). Collected also by Brewer and by Bolander.

Sphaerocarpus Californicus is closely related to *Sphaerocarpus Sphaerocarpus* (Dicks.),* differing chiefly in the longer and more pointed cylindrical-oblong or fusiform-clavate involucres, which in the latter species are commonly pyriform.

PLATE 100.

Figs. 9–12, *Sphaerocarpus Californicus.*
All figures are drawn from specimens collected in Mill Valley, Marin Co.
9. ♀ plant, with matured sporogonial involucres, natural size.
10. ♂ plant, × 12.
11. Portion of ♀ thallus with involucres of various ages, × 23.
12. Spore-tetrad, × 305.

2. **Sphaerocarpus cristatus** sp. nov.

♀ thallus suborbicular, 3–8 mm. in diameter, marginal cells of the unistratose lobes 30–45 μ, medial 45–60 μ: involucres .85–1.2 mm. high, sessile, thickly aggregated, at first cylindrical-oblong, soon becoming subglobose or obovoid, rounded at the apex, irregularly circumscissile with age at about the middle or the upper portion falling away in fragments, cells near the usually conspicuous orifice 30–40 μ, near the middle 45–80 μ × 30–40 μ: ♂ plant often once furcate with oblong-ovate segments: capsule .5–.8 mm. in diameter, on a seta about 40 μ in length, the bulbous foot usually accompanying the capsule when this is detached from the thallus; spores separating long before the maturity of the capsule, never persisting in tetrads, compressed, rounded-biconvex or sometimes concavo-convex, yellowish-brown, 65–80 μ in maximum diameter, cristate, the crests sinuous, 4–7 μ high, subcrenulate, 18–22 in number in the basilar circumference, mostly radiating from near the middle of each of the two faces, often 1–3 times furcate, sparingly anastomosing, forming sometimes 1–6 (rarely more) completely closed meshes in most cases near the middle of

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* *Targionia Sphaerocarpus* Dicks. Pl. Crypt. 1: 8. 1785.

Sphaerocarpus terrestris, minima, Mich. Nov. Pl. Gen. 4. *pl. 3.* 1729.

Spaerocarpus Michelii Bell. App. ad Fl. Pedem. 52. 1792 (*fide auctorum*). Mém. Acad. Roy. Sci. Turin, 5: 258. 1793.

Sphaerocarpus terrestris Sm. Eng. Bot. *pl. 297.* 1796.

the face; sterile cells cubico-spherical to oblong-cylindrical, 45–70 μ in longest diameter, obscure at maturity of the spores.

Exsicc. Hep. Am. 160 (as *Sphaerocarpus terrestris* Mich., var. *Californicus* Aust., a little of which is intermingled in the three sets examined).

California: near Stanford University,* May, 1892 (Professor D. H. Campbell); Berkeley, Feb. 15, 1896 (Howe).

Sphaerocarpus cristatus is a very remarkable species with no near relatives, so far as can be ascertained from accessible literature and specimens. The spores separate very early—at a time when they are still colorless and only 40–50 μ in diameter and when the surface markings have become scarcely visible. This early dissolution of the tetrad is a character of almost generic importance yet the gap in this respect between *Sphacrocarpus cristatus* on the one hand and *Sphaerocarpus Californicus* Aust. and *Sphaerocarpus Sphaerocarpus* (Dicks.) on the other, in which, so far as we have observed, the spores are *permanently* united in 4's, is bridged over somewhat by *S. Donnellii* Aust., from Florida, in which the spores separate at maturity. But the spores of *S. Donnellii* are quite different in their more angular outline and in their markings, being areolate instead of typically cristate and being also prominently tuberculate-papillate in the basilar circumference.

Professor Campbell (Erythea 4: 73–77. 1896) was the first to observe and record the separation of the spores in Californian specimens of *Sphaerocarpus* and it seems probable from his description and drawings that his interesting "Notes on *Sphaerocarpus*" (*l. c.*) were based, chiefly at least, upon *S. cristatus*.

Hep. Am. 160 in the herbarium of Professor Underwood we would name as the type of the species.

PLATE 100.

Figs. 1–8, *Sphaerocarpus cristatus*.

All figures are drawn from the type material.

1. ♀ plant, with matured involucres and sporogonia, natural size.
2. Portion of thallus with involucres of various ages, × 23.
3. Sporogonium, × 23.

*The locality given in Hep. Am. 160 is "San Mateo Co.," but Professor Campbell writes in reply to a request for a more precisely defined station that nearly all his Hepaticae have been collected within the limits of Santa Clara County, in which Stanford University is situated.

4 Antheridial involucre, × 23.

5 and 6. Opposite faces of a single spore, × 305 (the former is thought to be what was originally the outer face, chiefly because the ridges are here a little the stronger The number of completely closed meshes in the latter is unusually great).

7 and 8. Spores, × 305, the latter showing the flattening.

12. GEOTHALLUS Campb. Bot. Gaz. **21**: 13. *pl. 2.* 1896. Ann. Bot. **10**: 489. *pl. 24, 25.* 1896.

Gametophore transitional in character between the thalloid and foliose types of Hepaticae, consisting of a simple or dichotomous flattened axis several layers of cells in thickness, passing somewhat abruptly at the sides into large crowded irregularly succubous mostly unistratose leaf-like expansions and often bearing smaller irregularly disposed leaf-like laminae on the dorsal surface; cells large, thin-walled; root-hairs numerous, long, colorless. Dioicous. ♂ and ♀ plants similar, or the former slightly smaller. Sexual organs usually few, often standing near the axils of the leaf-like lobes, enclosed, in most cases singly, by unistratose involucres. Antheridia ovoid, on very short stalks, these composed of more than a single vertical series of cells, involucre flask-shaped. Archegonial involucres at first cylindrical or somewhat flask-shaped, becoming saccate or campanulate at maturity of the sporogonium, the orifice large. Calyptra mostly of two layers of cells, ruptured rather late, the upper part, with the archegonium-neck, persisting on the apex of the capsule.

Sporogonium consisting of a nearly spherical indehiscent capsule, a very short seta, and a bulbous foot. Capsule wall of a single layer of large, dark-colored cells, without annular or other local thickenings. Spores separate at maturity, very large, thick-walled, the inner face reticulate, otherwise smooth, accompanied by oval or ellipsoidal-cylindric, thin-walled, sterile cells.

1. GEOTHALLUS TUBEROSUS Campb. *l. c.*

Plant simple or once dichotomous, 5–7 mm. long, 3–5 mm. wide, perennial through the conversion of a large portion of its axis into an oval or flattened tuber: leaf-like lobes nearly horizontal or somewhat ascending, extremely variable in form, mostly oblong, obovate, or linear-ligulate, 1.5–2 mm. in length, rarely broader than long, sometimes cristate-laminate at base, the margins entire or slightly sinuate; marginal cells pentagonal, or subquadrate-oblong, 50–65 × 35 μ, the submarginal hexagonal-oblong or irregularly pentagonal, 50–100 μ × 35–60 μ, those toward the base of the lobes often becoming over 200 μ in length: ♂ involucre .45 mm. in height: capsule .8 mm. in diameter, seta about

90 μ long; spores nearly black, 120–150 μ in maximum diameter, spore-wall smooth or very minutely punctulate and very thick (8–12 μ) except as to the comparatively small inner face where it is thinner and bears reticulate ridges, the meshes about 15 μ in width; sterile cells 48–108 μ long.

On sandy soil, near San Diego (Mrs. Katharine Brandegee; March, April, 1895), associated with *Ophioglossum nudicaule*.

A remarkable plant, clearly allied to *Sphaerocarpus*, yet as clearly distinct from it generically. Living laboratory-grown specimens, bearing antheridia and archegonia, and mounted microtome sections of the mature sporogonium, have been furnished us through the generosity of Professor Campbell. Mature ♀ involucres we have not seen and our description of these is adopted from the author's description with the assistance of his figure 5 (Bot. Gaz. *l. c.*). We have seen the spores only in microtome sections, yet it seems certain from these that the spore-surface is reticulate upon the inner face and otherwise practically smooth, as described by Professor Campbell—a unique character, so far as our observations upon the Hepaticae go. In *Anthoceros*, *Riccia*, *Fossombronia*, etc., it is always the outer face of the spore that is the more conspicuously roughened. Doubtless the restriction of the ridges in *Geothallus* to the inner face is correlated in some way with the unusual thickness and rigidity of the spore-wall in the region of the outer face, especially as the ridges of the inner face are seen in section to be formed by a folding of the exospore, the contour of which is followed by the episporic coating.

The gametophore of *Geothallus* (as grown in the laboratory) much resembles in general appearance that of *Fossombronia longiseta*, though the "leaves" are stiffer, less crisped, and more horizontal.

The formation of tubers is a character which this hepatic shares with *Anthoceros dichotomus* Raddi, *Anthoceros Donnellii* Aust., *Anthoceros tuberosus* Tayl., *Anthoceros phymatodes* M. A. Howe, *Riccia vesicata* Tayl. (= *R. cancellata* Tayl. *fide* Stephani), *Riccia perennis* Steph., *Riccia bulbifera* Steph., *Petalophyllum Preissii* Gottsche, *Petalophyllum lamellatum* (Hook.) Lindb., and *Fossombronia tuberifera* Goebel. The stem of *Fossombronia longiseta* also is often more or less tuberously thickened at the apex, especially in specimens from the southern part of Cali-

fornia. This adaptation for carrying the plant over a season of drought will doubtless be found, when the species from the more arid regions of the earth come to be better known, to be more common among the Hepaticae and Anthocerotes than has been generally supposed, as has already been remarked by Herr Stephani. From the above showing it will be seen that the occurrence of tubers in *Geothallus* can receive no emphasis in the generic diagnosis, inasmuch as this is elsewhere evidently a specific rather than a generic character.

13. RICCARDIA S. F. Gray, [as *Riccardius*] Nat. Arr. Brit. Pl. 683. 1821.

Aneura Dumort. Comm. Bot. 115. 1822.

Gametophore a pinnately, palmately, or subdichotomously branched, rarely almost simple, somewhat fleshy thallus, composed, for the most part, of several layers of cells, with the interior cells considerably larger and more elongated than those of the surface, usually undifferentiated into costa and lamina though sometimes provided with a unistratose border, this, in its best development, giving the thallus, especially the younger branches, the appearance of being broadly costate. Root-hairs few. Monoicous, dioicous, or rarely paroicous, occasionally, perhaps, polyoicous. Antheridia spherical, immersed singly in loculi, commonly arranged in two parallel rows on a small, rounded, or most often, oblong or linear, lateral branch. Archegonia several, on a short subovate lateral branch, this by subsequent growth of the main thallus sometimes appearing to be attached ventrally; margin of the ♀ branch usually furnished with numerous narrow laciniae, these often produced into single rows of cells; base of the archegonium confluent with the thallus, the latter contributing more or less to the formation of the "calyptra." Calyptra tubular or pyriform, large, fleshy, its walls several layers of cells in thickness, the surface roughened near the apex when young [exc. in *Riccardia pinnatifida* (?)] by stout papillae or short trichomes. Involucres external to the calyptra represented only by the fringed margin of the ♀ branch, this becoming more or less coalesced with the base of the calyptra and usually quite inconspicuous.

Sporogonium an oval or oblong-ellipsoidal capsule on a somewhat long seta. Capsule before dehiscence with a short internal axile column at the apex, formed as if by continuation of the inner of the two layers of cells composing the capsule-wall, this column separating, on dehiscence, into four parts—the "elater-bearers"—

one portion remaining attached to the apex of each valve. Elaters unispiral, mostly somewhat attenuate at the ends, a few usually clinging to the "elater-bearers" and forming with them at the tip of each valve a pencil-like tuft. Inner layer of the capsule-wall with annular or spiral thickenings. Spores small.

Key to the Species.

Main axis of the thallus 3–6 mm. wide. 1. *R. pinguis.*

Main axis or principal branches less than 2 mm. wide.

Ramification pinnate.

Unistratose margin of branches one cell in width, obsolete in older parts. 2. *R. major.*

Unistratose margin of branches two or three cells in width. 3. *R. multifida ambrosioides.*

Ramification palmate.

Thallus translucent when moist, surface cells 45–118 × 29–50 μ, branches with unistratose margin one cell in width; monoicous. 4. *R. latifrons.*

Thallus opaque, surface-cells 23–59 × 15–29 μ, branches narrower, usually without trace of a unistratose margin, almost always gemmiferous at apex; dioicous. 5. *R. palmata.*

1. RICCARDIA PINGUIS (L.) S. F. Gray (as *Riccardius*), Nat. Arr. Brit. Pl. 1: 684. 1821.

Jungermannia pinguis L. Sp. Pl. 1136. 1753.

Aneura pinguis Dumort. Comm. Bot. 115. 1822.

Thallus broad, thick, rigid on drying, dull green, with a somewhat greasy lustre, simply pinnate or subpinnate, the main axis 3–6 mm. wide, apices rounded: dioicous: androecia suborbicular, becoming short-oblong, .76–1.7 mm. × .85 mm., often geminate, margin entire or crenulate; antheridia 4–13, irregularly disposed: ♀ branch with a laciniate margin, archegonia few; calyptra 3.5–5 mm. high, tuberculate or nearly smooth: capsule oval, brown; elater-bearers conspicuous, ¼–⅓ the length of the valves; elaters contorted, mostly 145–300 μ × 9–12 μ; spores brown, minutely papillose, 18–24 μ.

In mountain streams and very wet places. Hay Fork, Trinity Co. (no. 1119); Marin Co. (Underwood).

The larger simpler forms of this species may, when sterile, be confused with certain sterile conditions of the genus *Pellia*. Distinguishing marks are, the pinnate, instead of dichotomous, branching, apices rounded rather than emarginate, texture more rigid when dry, and a lustre as if saturated with some oleaginous compound. The sporogonium has not been found in the Californian

specimens. The above description has been completed from New York plants in herb. Underwood.

2. RICCARDIA MAJOR (Nees) Lindb. Musc. Scand. 5. 1879.

Aneura multifida major Nees, Naturgesch. Eur. Leberm. 3: 450. 1838.

Thallus rather broad (main axis .66–1.7 mm. wide), the branching sometimes regular and compact but more frequently loose and irregular, always pinnate or bipinnate; ultimate branchlets usually slightly biconvex but becoming plane or even concave ventrally or dorsally, the unistratose margin one cell in width, obsolete in the older portions: monoicous: androecium usually distant from ♀ branch, rather short, oblong or subovate, .23–.6 × .17–.32 mm., furnished with an erect, translucent, crenulate margin and bearing 1–6 (usually 3) pairs of loculi: ♀ branch broad, its margin multilaciniate; calyptra arcuate, clavate-cylindrical, 2.5–4.5 mm. high, .84–1.26 broad above, much roughened when young by short tubular trichomes, nearly smooth at maturity: capsule oblong-ellipsoidal, dark-brown or black; elater-bearers about $\frac{1}{7}$–$\frac{1}{9}$ the length of the valves*; elaters mostly 290–500 μ long, 12 μ in maximum width, the spiral band disappearing in the gradually attenuate ends, a few (from near the elater-bearers?) 180 × 15 μ, obtuse; spores brown, minutely papillose, 14–18 μ.

EXSICC. Hep. Am. 26 (as *Aneura pinnatifida* Nees).

Common in the Coast Range Mountains on moist banks and on logs and stones about streams. Mill Valley (1185, 1186), Marin Co.; Cazadero (1212) and Duncan's Mills (1213), Sonoma Co.; Ukiah (744), Navarro (Miss Edith S. Byxbee), and Mendocino (550), Mendocino Co.; Blue Lake, Humboldt Co.; Hay Fork (1118), Trinity Co.

So far as California is concerned, this plant is usually very distinct from *R. multifida ambrosioides* and it has seemed conducive to clearness to follow Lindberg in treating the variety of Nees as a species. Yet it must be admitted, we think, that transitional forms do occur in California, though rarely.

Riccardia pinnatifida we do not yet recognize from California. Hep. Am. no. 26, from Marin Co. seems to go better with *Riccardia major*. *Riccardia pinnatifida* differs from the latter species in the

* In measuring the "elater-bearers" the term is here restricted to the somewhat compact column made up of rigid tubes with annular or spiral thickenings and with the free extremities rounded.

softer, flatter thallus, without indication of a unistratose margin, in the looser texture, and according to authors, in being dioicous and in having a smooth calyptra. All specimens of *Riccardia pinnatifida* that we have had an opportunity of studying have, unfortunately, been sterile. It appears to be an aquatic plant, for the most part.

3. RICCARDIA MULTIFIDA AMBROSIOIDES (Nees) Lindb. Acta Soc. Sci. Fenn. **10**: 511. 1875.

Aneura multifida ambrosioides Nees, Naturgesch. Eur. Leberm. **3**: 450. 1838.

Thallus bi- or tri-pinnate, often expanding to form radiating clusters or half-rosettes, the branches crowded, rather narrow (.34–.85 mm. broad), biconvex with a unistratose margin two or three cells in width, thus presenting a quite clearly defined suggestion of a costa: monoicous, sometimes paroicous (rarely dioicous?): androecium usually distant from ♀ branch, oval, oblong, or linear, .65–.93 × .25–.33 mm., with a hyaline crenulate margin, and bearing 3–7 pairs of loculi, or 2 or 3 antheridia sometimes immersed in base of the ♀ branch (paroicous): margin of ♀ branch with copious laciniae, each commonly ending in a single row of cells; calyptra much roughened, 3–4 mm. high: capsule brown, oblong-ellipsoidal; elater-bearers about $\frac{1}{15}$ the length of the valves; elaters mostly 250–480 μ long, 18 μ in greatest width, attenuate at the ends; spores 15 μ, nearly smooth.

On decaying wood and moist banks. Olema (1187), Mendocino (586, 666), Eureka (964) and Hay Fork (1188). The last-mentioned specimen seems to be strictly dioicous, and a tendency to restriction of the two kinds of organs to separate individuals is sometimes to be observed in our other Californian specimens. The description of the sporogonium is drawn from no. 944, Jack, Leiner and Stizenberger, Kryptogamen Badens.

4. RICCARDIA LATIFRONS (Lindb.) Lindb. Acta Soc. Sci. Fenn **10**: 513. 1875.

Aneura latifrons Lindb. Not. pro Fauna et Flora Fenn. **13**: 372. 1874.

Thallus light green or darkening on drying, translucent when moistened, palmately divided; the ultimate branches oblong or linear, usually 2–4 mm. long, .83–1.32 mm. wide, commonly strongly emarginate, slightly convex dorsally, plane or subconcave

beneath, without suggestion of a costa, the unistratose margin only one cell in width, very rarely gemmiferous at apex; surface-cells pentagonal, hexagonal or irregularly oblong, large, pellucid, 45–118 × 29–50 μ: monoicous: androecium affixed to base of ♀ branch or distant, oblong, .66–.85 × .27–.33 mm., somewhat narrowed at base, with an erect laciniate margin, loculi about five pairs: ♀ branch with numerous small marginal laciniae mostly composed of a single row of cells; calyptra pyriform-clavate, slightly verrucose near apex, 2.5–3.5 mm. high, .75–1 mm. broad above: elaters 120–240 μ long, 15 μ in maximum width; spores brownish-green, minutely papillate, 13–21 μ.

On decaying logs. Redwood Cañon, Marin Co. (1184); Navarro (Miss Edith S. Byxbee) and Mendocino (592, 721, 676); Kneeland Prairie, Humboldt Co. (1023); near Hay Fork, Trinity Co. (1112, 1129); Sisson, Siskiyou Co. (39). The species was collected in California by Dr. Bolander, also, the exact locality unknown.

Lindberg's original description seems to call for a larger plant than ours, yet the Californian specimens agree very closely with G. & R. Hep. Eur. no. 493 and Sulliv. Musc. Allegh. no. 279, which were referred to *R. latifrons* by Lindberg, and also with specimens collected in Sweden by Arnell.

The branching may be subpinnate below, but ultimately is always pronouncedly palmate or subdichotomous.

5. RICCARDIA PALMATA (Hedw.) Carruth. Seeman's Jour. Bot. **3**: 302. 1865.

Jungermannia palmata Hedw. Theor. Gen. 87. *pl. 18. f. 93–95.* 1784.

Thallus opaque, compact, dark green on drying, palmately branched or subdichotomous, usually without trace of a unistratose border, almost always bearing gemmae at apices both dorsally and ventrally; gemmae of two cells, formed endogenously from cells of the surface; surface-cells small, quadrate-rhombic or oblong-pentagonal, 23–59 × 15–29 μ: dioicous: ♂ thallus narrow, biconvex, sometimes nearly terete, the branches .18–.35 mm. in width, rounded at apex or slightly notched; ♀ plants broader and larger, the segments .5–1 mm. wide: androecia oblong or linear, often in pairs, .5–1.1 × .25–.32 mm., with entire inflexed membranous margins, sometimes proliferous at apex, loculi 4–8 pairs at maturity: ♀ branch subentire, or with a few short and incon-

spicuous marginal laciniae, rarely proliferating, archegonia 5–18; calyptra strongly tuberculate: spores small, almost smooth, brownish-green.

On old logs. Russian Gulch, near Mendocino (715) and at Sisson (50—associated with *R. latifrons*).

We have observed no calyptra or sporogonium in the Californian plants and for the description of these parts have depended upon authors, especially Lindberg and Limpricht.

In *R. palmata*, nearly the entire surface-layer of the thallus sometimes becomes resolved into gemmae, after which the plant appears more translucent and as if composed of larger cells.

In one case alone out of many preparations from the specimens cited, we have seen what may have been a monoicous individual, but here we were unable to determine with certainty whether the union was really organic or due simply to adhesion.

METZGERIA Raddi, Atti Soc. Ital. Sci. Mod. **18**: —(34). 1818. Mem. Mat. e Fis. Soc. Ital. Sci. Mod. **18**: 45. 1820.

In the manuscript on the Californian Hepaticae prepared by Dr. Watson and Mr. Austin (see page 10), there is to be found a short description of *Metzgeria conjugata* Lindb., followed by the remark: "A few fronds, insufficient for proper determination, but apparently agreeing with this description, were found among the specimens of *Frullania Grayana*, var., collected by Bolander." A "*Metzgeria furcata* Nees" is included among the seven Hepaticae enumerated by Sullivant in the Report on the Botany of Whipple's Expedition,* but whether this was collected within the limits of California or not is a matter of uncertainty. As we have seen no California specimens of *Metzgeria*, we will not attempt any description of its species. It is hoped that the brief diagnosis given in the key to the genera of the *Metzgeriaceae* will suffice for the recognition of the genus. At least two species of *Metzgeria* occur farther to the northward on the Pacific Slope, and there is little doubt that the genus is represented in California.

14. PELLIA Raddi, Atti Soc. Ital. Sci. Mod. **18**: —(38). 1818. Mem. Mat. e Fis. Soc. Ital. Sci. Mod. **18**: 49. 1820.

Gametophore a thin or somewhat fleshy, irregularly dichotomous, undulate-margined thallus without ventral scales, growing in thick masses with imbricate-ascending lobes or scattered, bright

* Pacific R. R. Survey, **4**: 191. 1857.

green, darkening with age or on drying, usually soft and flaccid when soaked out, furnished with a broad, for the most part indistinctly defined costa (9–16 cells in thickness), this passing gradually into the wide unistratose somewhat sinuate-lobed margin; root-hairs springing from the costa, brownish, numerous. Monoicous or dioicous. Antheridia oval, short-stalked, immersed, usually singly, in loculi irregularly distributed along the dorsal surface of the costa. Archegonia in groups of 4–18, borne in a pocket-like cavity near the apex of the costa, becoming dorsal by the subsequent growth of the thallus, covered more or less by an involucre opening in front. Involucre at maturity of sporogonium a mere flap or scale at the posterior margin of the cavity or becoming tubular or forming a short and narrow ring, the margin crenulate or lacerate. Calyptra exserted from the involucre or included, its walls composed of several layers of cells.

Sporogonium consisting of a spherical, light brown or yellowish, 4-valved capsule on a very long delicate seta; capsule-wall bistratose, cells of the outer layer with yellowish-brown trigones or nodular thickenings, those of the inner layer with semiannular or imperfectly spiral thickenings (wanting or rudimentary in *P. endiviaefolia*), "elater-bearers" and elaters both present, the former 20–100 in number, persistently attached to the base of the capsule, 1–6-spiral, differing more or less in character from the true elaters; the latter 2–4-spiral, mostly rather obtuse, often, together with the spores, remaining for a time clinging to the elater-bearers and forming a globular entangled mass at the base of the valves. Spores very large, multicellular at the time of dehiscence, oval or ellipsoidal, punctulate.

1. PELLIA NEESIANA (Gottsche) Limpr.; Cohn, Krypt. Fl. Schles. 1: 329. 1877.

Pellia epiphylla, forma Neesiana Gottsche, Hedwigia, 6: 69. 1867.

Dioicous: ♀ plants somewhat sparingly dichotomous, with oblong or linear branches; ♂ plants forming dense mats with numerous broad crenate overlapping ascending segments: involucre forming a short tube, 1–2 mm. high, with a lacerate margin; calyptra exserted 1–3 mm.: capsule 1.5 mm. in diameter on seta 3–5 cm. long; cells of inner layer of capsule-wall with often imperfect semiannular thickenings; contents of capsule in part persisting for some time after dehiscence in an intertangled globular central mass; elater-bearers about 30, stout, conical- or blunt-pointed, 120–270 μ × 18–36 μ, mostly 3- or 4-spiral, sometimes bispiral or annulate; elaters strongly contorted, 2-, or more rarely,

3-spiral, 225–400 μ × 9–12 μ; spores 84–105 μ × 51–69 μ, 4 or 5 cells in length and 2 or 3 in greatest width.

On banks of streams, along the North Fork of the Little River, Mendocino Co. (605, 654, 657).

Pellia epiphylla (L.) Corda and *P. endiviaefolia* (Dicks.) Dumort.* may both occur in California. *P. epiphylla* differs from *P. Neesiana* in being monoicous and in the reduction of the involucre to a scale or flap on the posterior margin of the cavity from which the calyptra arises. *P. endiviaefolia* [*P. calycina* (Tayl.) Nees] is dioicous, but differs from both the others in the greater development of the involucre, which forms a tube about 4 mm. high, from which the calyptra scarcely ever protrudes, and is markedly different from both in characters of elaters and elater-bearers, the latter being, according to Jack,† often as many as 100, much longer and more slender (600–800 μ × 5 μ) and bispiral, while the true elaters are shorter than in the other two species (150–200 μ), less contorted, and 3- or 4-spiral. Semiannular thickenings, conspicuous on the inner wall of the capsule of *P. epiphylla* and *P. Neesiana*, are wanting or obscurely developed in *P. endiviaefolia.*

A sterile *Pellia* was collected in 1894 by Messrs. M. S. Baker and F. P. Nutting in the mountains south of Dixey Valley in Lassen Co., but the species is scarcely determinable. Dr. Bolander lists "*P. calycina*" in his "Catalogue of the plants growing in the Vicinity of San Francisco," but we have been able to see no *Pellia* of Dr. Bolander's collecting.

15. BLASIA L. Sp. Pl. 1138. 1753. Ex Mich. Nov. Pl. Gen. 14. 1729.

Gametophore dark- or bluish-green, becoming yellowish, usually several times dichotomous, forming rosettes or irregularly tangled tufts, somewhat transitional in character between the thalloid and foliose types, 5–10 cells in thickness along the narrow or expanded costa, becoming gradually thinner toward the unistratose border, the latter sometimes merely crenulate or sinuate but more often running out into rounded, distant, or close and incubous, leaf-like lobes; root-hairs colorless, springing from the costa, often numerous toward the base and fastening the plant closely to the substratum. Underleaves represented by small, oblong, ovate, or

* Rec. d'Obs. Jung 27. 1835.

† Flora, 81: 6, 7. 1895.

heteromorphic, dentate scales, in an irregular row on each side of the costa, attached by the posterior margin or near the middle with the margins free. On the ventral surface, also, are small, hollow, subspherical organs, the "leaf-auricles," usually two near the base of each lateral lobe, their cavities commonly soon occupied by colonies of *Nostoc*.* Marginal cells of the lateral lobes 20–30 μ, oblong, quadrate, or oval, each often with a salient point, remaining cells of lobe 30–60 μ, rhombic-hexagonal, surface cells of the axial region more elongated. Gemmae of two kinds; one borne in dorsal flask-shaped receptacles formed out of the substance of the apex of the costa and appearing single, paired, or in threes, according to the development of the branch-system, furnished at maturity with a long slender neck (1–2 mm. × .17–.3 mm), the neck-wall 2–4 cells in thickness, the gemmae flattened-oval, 90–135 μ, 3–5 cells wide, 2 cells thick or unistratose at margin, borne on slender hyaline pedicels arising from the base and sides of the receptacle, the pedicels accompanied by short, clavate, unicellular trichomes; second form of gemmae on the dorsal surface of the younger portions of the plant, scale-like, stellate or coarsely dentate, of a single layer of cells near their margin, of two or more layers toward the middle. Dioicous. ♂ plants smaller; antheridia several, immersed singly in a row along the dorsal surface of the costa. Archegonia numerous, on dorsal surface of the costa toward the apex, the single fertilized archegonium becoming, by the arching over of the adjacent parts, completely enclosed within a cylindrical or clavate inflation of the costa, this 3–4 mm. in length, directed forward, finally ruptured at the anterior end by the elongating sporogonium, and functioning as an involucre. Calyptra light-colored, membranous. Capsule oval, dingy brown, 1–1½ mm. long, dehiscing by 4 (4–6) valves, inner surface with annular or spiral thickenings, the outer surface showing brownish nodules in the radial walls; seta rather thick, 1¼–2 cm. long. Spores ovoid or somewhat angular, 38–50 μ, slightly granulate, long remaining with the elaters in a central globular mass. Elaters 200–300 μ × 10–14 μ, with two spiral bands, these often becoming paired by splitting.

The only known species is

1. BLASIA PUSILLA L. *l. c.*

Jungermannia Blasia Hook. Brit. Jung. *pl. 82–84.* 1816.

* The *Nostoc* colonies are thought to live in symbiotic relations with the ***Blasia***, perhaps serving as reservoirs of moisture (Goebel, in Schenk's Handbuch der Botanik, **2**: 360. 1882). The colony is surrounded ventrally by a single layer of cells and is penetrated by a branching tube which springs from the wall of the cavity.

Beside a pool, Blue Lake, Humboldt Co. (1002). Our specimen is simply gemmiferous; the above description of the sporogonium is drawn from a Swedish plant collected by Dr. Arnell.

16. FOSSOMBRONIA Raddi, Atti Soc. Ital. Sci. Mod. **18**:— (29). 1818. Mem. Mat. e Fis. Soc. Ital. Sci. Mod. **18**: 40. 1820.

Gametophore consisting of a creeping, simple, furcate, or innovating stem with 2-ranked, obliquely inserted succubous leaves. Stem flattened above, closely attached to the substratum by very long, mostly violet- or vinous-purple root-hairs. Leaves assurgent or subvertical, undulate-crisped, especially on drying, usually imbricate, subquadrate, often broader than long, the bases extending far onto the dorsal side of the stem and more or less decurrent, margins in most cases irregularly sinuate-lobed, sometimes toothed, rarely subentire; small subulate paraphyllia-like appendages often occurring, especially on dorsal surface of the stem; leaf-cells large, thin-walled, often in two or more layers near the base, cuticle smooth. Monoicous (commonly heteroicous, *i. e.*, paroicous and synoicous), sometimes dioicous. Antheridia spherical or oval, on about equally long stalks, standing singly or in groups of 2–4 on the dorsal side of the stem near the bases of the leaves. Archegonia similarly situated (the fertile one, however, always near the stem-apex), single or in groups of several, sometimes closely associated with the antheridia. The fertilized archegonium becoming surrounded by a large campanulate or goblet-shaped involucre, this commonly open or incised to the base in front (*i. e.*, toward the stem-apex), the wide mouth undulate-lobed or dentate. Involucre often surrounded by several small subulate or linear-lanceolate scales, these in most cases finally adnate to the involucre and forming slight wing-like ridges. Calyptra free, thin.

Sporogonium a spherical capsule on a short, rarely somewhat elongated seta arising from a subglobose "foot." Capsule brown or when young and living nearly black, irregularly dehiscent or imperfectly 4-valved, the wall bistratose, cells of the inner layer with often incomplete semiannular thickenings. Spores large, several times broader than the elaters, round tetrahedral, somewhat flattened, the outer face echinate, verrucose, reticulate-alveolate, or bearing free or anastomosing crests, the small inner faces much less strongly roughened, in most cases simply punctate, verrucose-papillate, or marked with short, low ridges. Elaters usually 2- or 3- (1–4-) spiral.

1. FOSSOMBRONIA LONGISETA Aust. *p. p.* [as synonym] Proc. Acad. Nat. Sci. Philad. 1869: 228. 1869.

Androcryphia longiseta Aust. *l. c.*

Stems mostly 6–15 mm. long and once dichotomous, rather stout (15–20 cells in thickness), commonly somewhat tuberously thickened at apex and perennial through the resumption of apical growth on termination of the dry season, root-hairs vinous-purple: leaves 1.5–3 mm. long, subquadrate, assurgent or nearly horizontal, more or less imbricate, irregularly lobed, toothed, or subentire, often of 2–5 layers of cells toward the base; leaf-cells 30–45 μ × 40–60 μ near the margin, 40–60 μ × 60–150 μ near the base; monoicous (polyoicous?): involucre usually large, 1.5–3 mm. high, campanulate, open to the base on the side toward stem-apex or often connate here forming a complete cup, usually with several subulate squamules adnate to the outer surface, these mostly short but sometimes reaching nearly to the lobate-dentate mouth: seta finally 8–18 mm. long; capsule 1–1.2 mm. in diameter, the semi-annular thickenings of the inner layer of the wall mostly incomplete: spores yellowish-brown, distinctly compressed, 38–50 μ* in maximum diameter, strongly and somewhat remotely cristate, the crests high, projecting 3–6 μ at the margin, 20–30 in number in the basilar circumference, more or less obliquely ascending, slightly flexuous, thin, acute, usually undulate-serrulate, unequal in length, disappearing or sparingly confluent at the middle of the face, forming there very rarely 1–3 fully closed meshes; crests sometimes mostly replaced by subacute or truncate spines, these often numerous and crowded, 30–40 in number in the basilar circumference: elaters bispiral, 150–270 μ in length.

On banks and beside paths. Clarendon Heights, San Francisco; Mill Valley, Mt. Tamalpais, and Lake Lagunitas, Marin Co.; Duncan's Mills, Sonoma Co.; Ukiah (743, 785), Mendocino Co.; Blue Lake (998), Humboldt Co.; Lake Pilarcitos, San Mateo Co.; Reche Cañon, San Bernardino Co. (Parish, no. 3614); Pasadena (A. J. McClatchie); San Diego (Mrs. Katharine Brandegee). Collected also by Dr. Bolander; and by Prof. W. H. Brewer at "Egon Pass" (in herb. W. H. Pearson).

EXSICC. Hep. Bor.-Am. 118 (*p. p.*?).
Hep. Am. 157.

The "type specimen" of *Fossombronia longiseta* appears not to exist either in that portion of the Austin collection owned by

* Measuring to the extremities of the crests.

Mr. Pearson or in that in possession of the Owens College at Manchester. The species was distributed by Mr. Austin a few years after its publication as no. 118 Hep. Bor.-Am., but we have been unable to examine the spores in this, owing to the imperfect and fragmentary condition of the only specimen we have seen. Here, as after the original description, Texas as well as California was cited as furnishing the species, but the Texas plant, according to Lindberg (who gave it the name *F. Texana*), would appear to be quite a different thing, having areolate spores and being thus allied to *F. angulosa*. A specimen of *F. longiseta*, which may be a portion of the original material studied by Mr. Austin, is to be found in herb. Underwood marked "California, ex herb. C. F. Austin, comm. O. D. Allen." The original description, it should be noted, calls the species *dioicous*, while our specimens can, in most cases, be shown to be *monoicous*; yet capsule-bearing plants are sometimes found which exhibit numerous abortive archegonia on the back of the stem without traces of antheridia in any part. The two kinds of organs seem never to be closely associated in this species. Plants collected on January 7, 1896, near Lake Lagunitas, Marin Co., which we believe to be of this species, though not spore-bearing, show numerous antheridia along the back of the stem, and, from the examination with a pocket lens at the time of gathering, the specimens were thought to be purely ♂, but it was demonstrated on dissection that each bore also a number of archegonia near the stem-apex. The truth in the matter seems to be that the plants are perennial in most cases at least and that each plant has alternating periods of archegonia- and antheridia-production and that the two successive periods of production of either organ may sometimes be quite widely separated.

Fossombronia longiseta is allied to *F. pusilla* (L.) Dumort. and *F. Wondraczeki* (Corda) Dumort. (*F. cristata* Lindb.), but is sufficiently distinct from both in the longer seta, the rather larger leaves and leaf-cells, the arrangement of the sexual organs, probably in the perennial habit, and, in most cases at least, in the spore-markings. The crests of the spores are usually high, as in *F. pusilla*, but are commonly more numerous and often show a tendency to become broken up into spines, thus affording a transition to the purely echinate type of *Fossombronia* spore. The spore-

markings are extremely variable, and it is possible that two or more species should be recognized in the Californian specimens, but we have been unable to draw separating lines in any satisfactory way. The difference between a purely and rather remotely cristate spore like that represented in our figure 18 and one in which the crests are nearly all replaced by narrow spines, very numerous and densely crowded in the basilar circumference, like that shown in fig. 20, is very striking, but forms that seem to be intermediate exist, as is shown by our other figures. It is worthy of remark that the spores (fig. 17) of the specimen "ex herb. C. F. Austin," alluded to above, bear more spines than crests; the spines are here somewhat shorter than in specimens from the southern part of the state [Pasadena (McClatchie); San Bernardino Co. (Parish)]. All the specimens that we have seen from stations north of San Francisco have spores of the purely cristate type, having, on the whole, more in common with the spores of *F. pusilla* than with those of *F. Wondraczeki.*

PLATE 99.

16–20. *Fossombronia longiseta* Aust. Spores, × 305.

16. From Clarendon Heights, San Francisco, Mar. 28, 1896.

17. From specimen in herb. Underwood marked "California, ex herb. C. F. Austin, comm. O. D. Allen."

18. From Mill Valley, Marin Co., Apr. 4, 1896.

19. From specimen in herb. Underwood, marked "San Francisco, Cal., coll. T. S. Brandegee."

20. From Pasadena (A. J. McClatchie).

Family IV. JUNGERMANNIACEAE.

Apex of the gametophore (or of some of its branches) at length directly transformed into an archegonium. Sporogonia always terminal on the main axis or on the branches. Gametophore a leaf-bearing stem.* Leaves in two lateral rows, in addition to which there is often a ventral row of "underleaves" commonly differing from the lateral in size and form. Antheridia borne in the axils of more or less modified leaves ("♂ bracts"). Archegonia usually surrounded by a special involucre, the "peri-

* In three exotic genera, there is a prominent thalloid or filamentous phase, but this, in two of the cases, at least, is doubtless to be homologized with the protonema rather than with the gametophore. In all, the branches bearing the sexual organs are foliose.

anth," which, in many cases, at least, represents a union of the leaves of the adjacent cycle. The leaves (" ♀ bracts ") and underleaf (" bracteole ") subtending the perianth often somewhat modified.

Capsule quadrivalvate (the valves very rarely again cleft). Elaters always developed in association with the spores.

More than four fifths of all the species of Hepaticae of the world, according to Schiffner, belong to the present family.

Key to the Genera of Jungermanniaceae.*

Underleaves present throughout.

Leaves complicate-bilobed, the ventral lobe much the smaller.

Ventral lobe usually inflated, sac-like, helmet-shaped, or obovoid-clavate, rarely explanate; underleaves bifid. 35. *Frullania.*

Ventral lobe plane or with revolute margins, ovate to linear-lanceolate, sometimes nearly separate from the dorsal; underleaves entire or dentate. 34. *Porella.*

Leaves with 2–5 lobes or teeth, or divided to the base into capillary segments, never acutely complicate.

Leaves bifid or bidentate.

Underleaves much smaller than the leaves and usually different in form.

♀ branch a fleshy almost leafless subterranean sac depending from the ventral surface of the stem; the appressed underleaves bifid to the middle or below, with rather narrow sinus and nearly parallel lobes, otherwise entire. 25. *Geocalyx.*

♀ stem or branch comparatively little modified, conspicuously foliose.

Root-hairs in tufts at the base of the underleaves, the latter deeply bifid, the somewhat spreading segments again cleft or externally unidentate near the base; perianth more or less triangular-prismatic, the third angle always dorsal. 23. *Lophocolea.*

Root-hairs irregularly scattered; perianth triangular-prismatic, at least when young, the third angle always ventral. 26. *Cephalozia.*†

Root-hairs irregularly scattered; perianth ovoid, obovoid, or cylindrical, sometimes slightly compressed laterally, terminal on main stem or leading branches, now and then falsely dorsal. 21. *Lophozia.*

Underleaves similar to the leaves both in form and size. 30. *Anthelia.*

Leaves with 3–5 principal lobes or teeth, these more than one cell wide at base.

Leaves 3- or 4-lobed to about the middle (in our species); the lobes entire, somewhat acute, incurved; underleaves a little smaller than the leaves, otherwise similar; perianth on short branch arising from the axil of an underleaf. 28. *Lepidozia.*

* The present key is based, for the most part, upon the known Californian representatives of the various genera, and may not always apply to extra-limital species.

† Underleaves are rather uncommon in this genus outside of the ♀ branches, where they are always represented.

Leaves 3- or 4-cleft to below the middle; the segments filiform-acuminate, entire or more or less ciliate-fringed; antheridia on the main stem or lateral branches; perianth really acrogenous (*i. e.*, terminal on main stem or principal branches), but finally, through innovation, on a short, falsely lateral branch. 31. *Ptilidium.*

Leaf-lobes 3–5, obtuse, acute, apiculate, or spinescently pointed, the sinuses not extending to the middle; underleaves very different from the leaves, usually deeply bifid and often ciliate-fringed; perianth acrogenous; plants usually large. 21. *Lophozia* (§ *Barbatae*, not yet found in California).

Leaves divided to the base into 2–4 capillary segments; underleaves similar. 29. *Blepharost ma.*

Leaves entire or merely retuse at apex (sometimes bidentulate in *Kantia*).

Leaves incubous (*i. e.*, the anterior margin covering the posterior margin of the next leaf in front); underleaves suborbicular to ovate, emarginate or bifid; ♀ branch a fleshy almost leafless subterranean sac depending from the axil of an underleaf. 27. *Kantia.*

Leaves succubous (*i. e.*, the anterior margin covered by the posterior margin of the next leaf in front).

Plants with creeping, nearly or quite leafless, rhizomatous primary stems and ascending foliose branches; leaf-margin usually more or less dentate; underleaves minute, subulate and entire or 2- or 3-cleft. 22. *Plagiochila.*

Plants without rhizomatous primary stems; leaves without marginal teeth (but often retuse or bilobed at apex in *Lophocolea heterophylla*).

Root-hairs, when present, in tufts at the base of the underleaves; leaves immarginate; capsules dehiscing by straight valves.

♀ branch very short; the bracts a single pair, with sometimes rudiments of a second, very much smaller than the leaves; androecium on the main stem. 24. *Chiloscyphus.*

♀ branch longer, bracts (♀ and ♂) 3–5 pairs; paroicous. 23. *Lophocolea* (*L. heterophylla*).

Root-hairs long and numerous, springing from nearly all parts of the often reddish-purple ventral surface of the stem; leaves mostly linguiform, margined by a row of enlarged cells, trigones conspicuous; capsule dehiscing spirally, the valves very long and slender. 18. *Gyrothyra.*

Underleaves wanting throughout or present only in association with the ♀ bracts.*

Leaves complicate-bilobed.

Ventral lobe much the smaller; root-hairs springing from a mammilliform outpocketing of the ventral lobe near its base. 33. *Radula.*

Ventral lobe the larger (the two lobes rarely equal); root-hairs springing from the stem.

Perianth strongly compressed dorso-ventrally (parallel with the plane of the "frond"); fold of the leaf usually acute, often alate; root-hairs commonly scanty on the foliose branches. 32. *Scapania.*

* *Chiloscyphus polyanthos rivularis* may be sought here, inasmuch as the underleaves are commonly destroyed or wanting except in the youngest parts, where, however, they may always be demonstrated.

Perianth not compressed dorso-ventrally, deeply plicate at mouth; leaf folded at about a right angle, the fold rounded; lobes acuminate, obscurely crenulate toward apex; root-hairs long and numerous.
21. *Lophozia* (*L. ovata*).

Leaves with two nearly equal lobes or teeth, never acutely complicate.

Archegonia terminal on the main stem; uppermost pair of ♀ bracts more or less highly connate, enclosing the delicate perianth, to the lower part of which the bracts are adnate; leaves typically transverse.
17. *Marsupella.*

Archegonia usually terminal on short, ventral branches; perianth free from the bracts, much exserted, triangular-prismatic, at least when young, the third angle always ventral; branches, typically, all of ventral origin
26. *Cephalozia.*

Archegonia terminal on the main stem or principal branches; ♀ bracts free from each other and from the perianth; perianth oval to cylindrical-obovoid, never triangular-prismatic, commonly plicate toward the mouth; leaves succubous. 21. *Lophozia.*

Leaves with 3–5 lobes. 21. *Lophozia.*

Leaves entire (or in *Plagiochila* often dentate-margined), never bilobed

Plants with creeping, nearly or quite leafless, rhizomatous primary stems and ascending foliose branches; leaf-margins usually somewhat dentate.
22. *Plagiochila* *

Plants without rhizomatous primary stems; leaf-margins entire or merely repand.

♀ bracts more or less adnate to base of perianth. 19. *Nardia.*

♀ bracts wholly free from perianth. 20. *Jungermannia.*

17. MARSUPELLA Dumort. *p.p.* Comm. Bot. 114. 1822.

Sarcoscyphos Corda; Opiz, Beitr. 652. 1829.†

Nardius S. F. Gray, *pro parte minima*, Nat. Arr. Brit. Pl. 1: 694. 1821.

Plants from large and stout to very small and slender, usually densely caespitose. Stems erect or ascending, very rarely prostrate, subsimple or dichotomously branched, commonly sending out stolons or nearly leafless flagella from near the base, root-hairs in most species infrequent except at base and on the stolons. Leaves patent or erecto-patent, always bilobed; in the typical species transversely inserted, disposed in opposite ranks, canaliculate-concave or subcomplicate-carinate, the plant thus appearing compressed dorso-ventrally; in *M. Bolanderi* often obliquely inserted and distinctly succubous. Underleaves wanting. Usually dioicous or paroicous, rarely autoicous or synoicous. ♀ bracts commonly

* Structures representing underleaves are commonly present in the North American *Plagiochilae* but they are often so minute and fugacious that they may sometimes escape observation.

† See footnote, p. 33.

2–4 pairs, larger and less deeply lobed than the cauline leaves, the inmost pair more or less highly connate at base and fused with the lower part of the perianth and the hollowed-out upper part of the stem to form a somewhat goblet-shaped involucre. Perianth delicate' included in the involucre, irregularly 4–6-lobed after the exsertion of the capsule. Calyptra free or, toward the base, adnate to the perigynial tube. Capsule globose or slightly elongated, the valves of 2 or 3 layers of cells, the walls of which exhibit numerous brown nodular or imperfectly semiannular thickenings. Elaters bispiral.

Key to the Species.

Stems 2–6 mm. long; leaves in sterile and lower part of ♀ plants somewhat obliquely inserted and succubous; median leaf-cells 16–36 μ; antheridia single or in pairs; ♀ bracts nearly always margined with radially elongated cells. 1. *M. Bolanderi.*

Stems 5–80 mm. long; leaves always transversely inserted and canaliculate-concave or subcomplicate; median leaf-cells 16–28 μ; antheridia in groups of 2–6; ♀ bracts very rarely submarginate. 2. *M. emarginata.*

1. MARSUPELLA BOLANDERI (Aust.) Underw. Zoe, **1**: 365. 1890.

Sarcoscyphus Bolanderi Aust. Bull. Torr. Bot. Club, **3**: 9. 1872.

Nardia Bolanderi Aust.; Underw. Bull. Ill. State Lab. Nat. Hist. **2**: 113. 1884.

Densely and intricately caespitose, lurid green or dusky red, often blackening: stems prostrate or ascending at apex, rarely suberect, 2–6 mm. long, .1–.22 mm. in diameter, simple, sparingly branched below, or innovating from the axils of the ♀ bracts, furnished to the apex in most cases (especially in the ♀ plants) with somewhat copious colorless root-hairs: leaves close or distant, variable in size and position, ovate-orbicular, usually broader than long, .14–.36 mm. in length, .22–.55 mm. in width, subtransverse and erecto-patent in ♂ plants and toward the perianth in the ♀, otherwise mostly patulous-subvertical (turned toward the dorsal aspect of the stem) and succubous, sometimes obscurely marginate, concave, occasionally subcomplicate, rarely almost plane, emarginate-bilobed ¼–⅓ their length, the sinus acute or somewhat obtuse, the lobes triangular-ovate, mostly obtuse; leaf-cells rather thin-walled, with small or obsolete trigones, the marginal subquadrate, 16–25 μ, sometimes becoming a little elongated radially, the median mostly rounded-hexagonal, 16–36 μ, cytoplasm in exposed parts containing a diffused reddish-brown pigment: dioicous: antheridia single or more commonly in pairs, on stalks a little shorter than their long diameter, the ♂ bracts often distinctly bordered with subquadrate cells a little elon-

gated radially, the dorsal margins usually subrevolute: ♀ bracts 3 or 4 pairs, rather abruptly 2–6 times larger than the leaves, nearly always distinctly marginate with radially elongated often more highly colored cells 25–45 μ in greatest diameter, median cells oval-elliptical, 25–50 μ; inmost pair of bracts finally the largest, more or less highly connate, forming an exserted perianth-like, cylindrical or goblet-shaped involucre from a somewhat obconical base, emarginate-bilobed (rarely trilobed) 1/8–1/6 their length; outer bracts transversely inserted, erecto-patent, bilobed 1/6–1/4 their length, otherwise entire or slightly repand, the lobes obtuse: perianth subpyriform, a little shorter than the involucre, free in the upper third or half, with 4–6 connivent lobes at the mouth: calyptra mostly of two layers of cells: capsule dark brown, globose, .4–.45 in diameter, the walls of the cells with very numerous nodular thickenings; seta 2–4 mm. long.

On or about rocks or on exposed banks, sometimes under chaparral; hills and ridges of the Coast Range Mountains. San Francisco: Mission Dolores (Bolander), Clarendon Heights (Howe); Mt. Tamalpais and near Lake Lagunitas, Marin Co.; Pieta, Mendocino Co. (804); near Lake San Andreas, San Mateo Co. Often associated with *Cephalozia divaricata*, to which, sometimes, the more slender forms bear a superficial resemblance. Near Lake San Andreas, it grows in company with *Scapania nemorosa*, *Nardia crenulata*, *Cephalozia Turneri*, and *Marsupella emarginata*. It is always readily distinguishable from the smaller conditions of the last-named species by its darker color, the often distinctly succubous leaves, the larger and thinner-walled leaf-cells, the nearly always marginate ♀ bracts, the more exserted perianth-like involucre formed by the inmost pair of bracts, the fewer antheridia to each perigonial leaf, the smaller, darker, and more nearly spherical capsule, etc.

All of the minute European *Marsupellae* described more recently by Limpricht and by Spruce seem to be abundantly distinct from *Marsupella Bolanderi*. The larger and otherwise different *Marsupella sphacelata erythrorhiza* (Limpr.) [under *Sarcoscyphus* in Cohn, Krypt.-Fl. Schles. 1: 248, 431. 1877] is possibly its nearest ally, judging from specimens kindly communicated by Professor Limpricht.

The often obliquely inserted, subvertical, and distinctly succubous character of the leaves in *Marsupella Bolanderi* serves to

bridge over one of the more important gaps between the genera *Marsupella* and *Nardia* as defined by Spruce and accepted by most of the modern writers on hepaticology.

PLATE 101. MARSUPELLA BOLANDERI.

1. Plants, natural size.

2, 3. Apical portions of plants, showing innovations from axils of ♀ bracts, × 12.

4. Apical portion of a sterile plant, lateral view, showing succubous leaves, × 23.

5–7. Dorsal, lateral, and ventral views of apex of different ♀ plants, showing bracts, etc., × 23.

8. ♂ plant, × 23.

9. ♂ bract and antheridia, × 23.

10. A sterile (♀?) plant, × 23.

11. Cauline leaf, × 23.

12. Cauline leaves, outer (convex) face, × 23.

13. Cauline leaves, inner (concave) face, × 23.

14. Involucre, opened to show perianth and sterile archegonia, calyptra removed, × 23.

15. Margin of cauline leaf, × 225.

16. Part of ♀ bract, from one of the pair next subtending the perianth-like involucre, showing the radially elongated marginal cells, × 225.

Figures 10 and 15 from the original specimen ex herb. Austin; 2, 8, and 9, Mt. Tamalpais; 3, 12, 13, near Lake San Andreas, San Mateo Co.; 4–7, 11, 14, and 16, near Lake Lagunitas, Marin Co.

2. MARSUPELLA EMARGINATA (Ehrh.) Dumort. Comm. Bot. 114. 1822.

Jungermannia emarginata Ehrh. Beitr. 3: 80. 1788. Hook. Brit. Jung. *pl. 27.* 1816.

Sarcoscyphos Ehrharti Corda; Opiz, Beitr. 652. 1829.*

Nardius emarginatus S. F. Gray, Nat. Arr. Brit. Pl. 1: 694. 1821.

Variable in size and habit, usually stout, loosely or somewhat densely caespitose, green or often yellowish- or reddish-brown, sometimes dark purple: stems commonly erect, .5–8 cm. (mostly 1–4 cm.) high, simple or dichotomously branched, usually destitute of root-hairs except near base and on the numerous basal stolons: leaves rather firm and rigid, transversely inserted, canaliculate-concave or subcomplicate, patent or erecto-patent, mostly approximate, often imbricate toward the apex, quadrate-orbicular, .3–.9 mm. in diameter, from a broad base embracing one half the stem, emarginate or bilobed, the obtuse sinus rarely descending below one fourth the length of the leaf, the lobes broadly ovate, ob-

* See footnote, p. 33.

tuse or rarely acute; leaf-cells oval or round-hexagonal, the median 16–28 μ, the marginal usually a little smaller, all with large trigones: dioicous: antheridia in groups of 2–6, on stalks equaling their vertical diameter or sometimes twice as long, the bracts often with slightly revolute margins: ♀ bracts 2–4 pairs, gradually 2 or 3 times larger than the leaves, very rarely submarginate, the inmost pair highly connate, exserted or immersed, one or two of the exterior pairs sometimes connate at base, lobes similar to those of leaves, median cells 25–34 μ: perianth somewhat shorter than bracts, 4–6-lobed: capsule yellowish-brown, oblong-globose, .54–.7 mm. in length; seta 2–10 mm. long.

On a moist roadside bank near Lake San Andreas, San Mateo Co., Apr. 20, 1895—in company with the foregoing species.

18. GYROTHYRA M. A. Howe, Bull. Torr. Bot. Club, **24**: 201. 1897.

Stem creeping, foliose, subsimple or somewhat sparingly branching, radiculose. Leaves succubous, entire, alternate; underleaves present, free, bifid, segments narrowly lanceolate or subulate; walls of the leaf-cells with triangular thickenings at the angles. Antheridia short-stalked, in the axils of smaller saccate leaves, forming short median or, at first, terminal spikes. ♀ bracts 2–4 pairs (commonly 3 pairs). Perianth terminal, confluent for half its length or more with the bases of the bracts, the greater part of the calyptra, and the tissues of the stem, to form a thick-walled tube (perigynium), with a small bulbous or saccate base; perigynium erect or ascending, making, at maturity, nearly a right angle with the stem. Capsule cylindrical, long-exserted, dehiscing spirally by four very long and slender valves; capsule-valves of two layers of cells, the walls wholly destitute of spiral, semiannular, or other local thickenings. Elaters free, bispiral, acute or bluntly pointed; spores minutely papillate. "Involucellum" of the sporogonium foot well developed.

1. GYROTHYRA UNDERWOODIANA M. A. Howe, *l. c.* 202. *pl. 302, 303.*

Plants rather large, 1–2 cm. long, 2–4 mm. wide, mostly in compact light green tufts: stems creeping, thick, often slightly flattened dorso-ventrally, .5–.65 mm. in diameter, about 15 cells wide in cross section, very densely radiculose, slightly ascending at apex, subsimple or with a few irregularly disposed lateral branches, in female plant innovating from near base of perigynium; root-hairs long, nearly colorless or of a dilute yellowish-brown hue, some-

times tinged proximally with purple, springing in older parts of the stem from oblong or linear dark-purple callosities, made up of the closely coherent root-hair bases and of other ventrally elongated cells; leaves obliquely inserted, linguiform or oval, succubous, rather close, translucent, scarcely decurrent dorsally, often crowded and suberect at stem-apex, marginate, 1.7–4 mm. × 1.4–2 mm., commonly concave below, apex decurved; cells of the margin quadrate or oblong, equaling in size the adjacent or twice as large; other leaf-cells mostly quite regularly pentagonal or hexagonal, 25–70 μ in diameter, oblong and larger towards the base; all with conspicuous trigones: underleaves free, often wine-colored, .6–1 mm. long, bifid ½–⅔ their length into narrowly lanceolate or subulate segments, usually running out into a single series of cells at apex, concealed by the dense mat of root-hairs except in the younger portions of the stem: perigynium tubular, 1–1½ mm. in diameter, and, with the free portion of the perianth, 3–4 mm. long, erect or ascending, nearly at right angles with the stem, tinged with purple ventrally, bulbous or saccate at base; wall of perigynium-tube 5–20 cells in thickness: ♀ bracts 2–4 pairs (commonly 3 pairs), entire or repand, similar in form to the cauline leaves, margins approximate at base dorsally, distant ventrally; uppermost pair inserted at about middle of perianth-tube or, more rarely, at two thirds its height, erect, apex and dorsal margins narrowly reflexed and exposing the perianth, or closely appressed and wholly concealing it; next lower pair usually inserted at about one third height of perianth-tube, more broadly reflexed; the one or two basal pairs but slightly attached to perigynium; bracteoles inconspicuous, sometimes subentire and slightly adherent to base of bracts; bulbus of perigynium without radicles, but a dense tuft of root-hairs springs from the stem just back of the bulbus and long root-hairs come from the cells of the involucral leaves near their bases: perianth free for ⅓–½ its length, free portion nearly echlorophyllose, subtubular, somewhat inflated below, contracted and lax above, crenulate at mouth, 3–5 cells thick at juncture with perigynium-tube, 2 cells thick at mouth: calyptra fleshy, upper third or fourth free at maturity, 3–6 cells in thickness: dioicous: archegonia several, the unfertilized raised on the base of the free portion of calyptra: male plants more slender; antheridia (1–6) in the axils of smaller saccate leaves, forming spikes of 3–6 pairs of leaves decreasing in size upwards, appressed, apices patent or recurved, or, in uppermost pair, erect; antheridia ellipsoidal or pyriform, .15×.24 mm., on pedicels ⅓ as long; slender stems (male?) occasionally gemmiferous at apex, gemmae unicellular, 10–24 μ in diameter: capsule long-cylindrical; valves very slender, 3.3–6 mm. × .13–.17 mm., widely spreading when

dry, attached spiro-radially to a basal disc composed of large hyaline cells, flexuous, contorted, or spiral, when moistened—always with a spiral twist at the apex; foot of sporogonium forming a more or less goblet-shaped "involucellum"; seta 1½–2 cm. long; elaters bispiral, very rarely trispiral, acute or subobtuse, 210–420 μ × 12–15 μ; spores about 12 μ, minutely papillate.

Exsicc. Hep. Am. 184.

Near Eureka, Humboldt Co., June, 1896 (no. 1026); collected also by Prof. John Macoun (herb. Underwood), on earth in a brook, Burrard Inlet, British Columbia, April 6, 1889, and on rocks, British Columbia, April 29, 1889; and by A. A. and E. Gertrude Heller, near Montesano, Chehalis Co., Washington (June 7, 1898, no. 4289).

The leaves of the British Columbia and Washington plants stand with their margins more often erect than in the Californian specimens, upon which our description and figures are based. In the sterile condition, *Gyrothyra* somewhat resembles the larger forms of *Nardia scalaris*—also collected by Macoun on Vancouver Island (Can. Hep. 80)—but can readily be distinguished by the margined, linguiform, more translucent leaves, and by the bifid underleaves.

The ♀ bracts, though more or less apparently paired, are in a strict sense alternate like the cauline leaves, and a single unpaired leaf is sometimes found to occur inside the pair we have described as the uppermost.

It should be remarked that the actual dehiscence of the capsules has not been observed, but the extremely long valves, which on being soaked out take easily a position strongly suggestive of the paring of an apple, the spiro-radial attachment to the basal disc, the never failing spiral twist of the valve-apex, and the spiral lines readily discernible on the surface of the embryo capsule (fig. 10) make, in our judgment, the induction that the dehiscence is spiral so safe and certain that we have felt no hesitation in so describing it and basing the generic name upon this character. The absence of thickenings in the walls of the cells of the capsule valves is noteworthy. Schiffner states* of all the *Jungermanniaceae akrogynae*: "Die reife Kapsel besitzt eine aus 2 bis mehr Zellschichten

* Engler and Prantl, Nat. Pflanzenfam. 1^3: 71. 1893.

bestehende Wand, deren Innenschicht in ihren Zellen stets Verdickungsleisten enthält." In *Gyrothyra*, the transverse walls of these cells usually appear a trifle thicker than the longitudinal, but the walls are otherwise wholly without traces of local thickening.

In respect to structure of the sporogonial envelopes, *Gyrothyra* is one of several interesting transitions from the ordinary Jungermannia type to the various pouch-bearing genera. Considered from this point of view and from certain other gametophytic characters, its nearest affinities are undoubtedly to be found in that section of *Nardia* represented by *Nardia haematosticta* (Nees) Lindb., of Europe. In manner of dehiscence of capsule it recalls the marsupiiferous genus *Kantia;* but the valves of *Gyrothyra* are much longer and their cell-walls lack the local thickening, while, of course, no generic comparison of the two is necessary so far as the gametophore is concerned.

PLATES 102 AND 103.

GYROTHYRA UNDERWOODIANA.

1. Entire ♀ plant, × 5.
2. Cauline leaves, × 18.
3. Marginal and adjacent leaf-cells, × 225.
4. Transverse section through marginal portion of leaf, × 216.
5. Underleaves, × 24.
6. Transverse sections of stem, × 22, showing ventral callosity from which the root-hairs arise.
7. Antheridium, × 40.
8. Median sagittal section of perigynium and adjacent portions of stem, showing embryo sporogonium with capsule, seta, foot, and "involucellum," also unfertilized archegonia, perianth, insertion of ♀ bracts, the root-hair callosity, etc., × 23 (slightly schematized). The free part of the perianth as drawn here and in the next is proportionally rather too short and not sufficiently inflated below.
9. Sagittal section of mature perigynium from which the seta has been detached, showing fully developed calyptra and the unfertilized archegonia raised upon the base of its free portion, × 20 (slightly schematized).
10. Surface view of embryo capsule, exhibiting the spiral lines, which presumably bound the valves, × 50.
11. Valves of capsules, showing position taken by them when moistened, × 12.
12. Apex of a single valve, × 12.
13. Base of dehisced capsule from above, showing spiro-radial insertion of valves, × 36.
14. Cells of inner surface of capsule valve, × 150.
15. Elaters and spores, × 137.

19. NARDIA S. F. Gray [as *Nardius*] *p. p.* Nat. Arr. Brit. Pl. 1: 694. 1821.

Mesophylla Dumort. Comm. Bot. 112. 1822.

Alicularia Corda; Opiz, Beitr. 652. 1829.*

Plants medium-sized or small. Stems creeping or ascending, rarely suberect, simple or with a few latero-ventral branches: root-hairs usually long and numerous, often reddish. Leaves alternate, obliquely inserted and succubous or nearly transverse toward the perianth, often vertical-connivent, subreniform to orbicular-ovate, entire or merely repand, rarely retuse at apex, sometimes marginate. Underleaves present, lanceolate or subulate, or (in our species) wanting. Dioicous or paroicous. Androecium in dioicous species terminal or median, ♂ bracts saccate, otherwise similar to the leaves, antheridia mostly in groups of 2–4. Archegonia terminal on the main stem. ♀ bracts 2–5 pairs: in the subgenus *Eunardia*, the superior opposite, connate in pairs, fused with the base of the perianth and the hollowed-out stem-apex to form a perigynial tube, this sometimes ventrally bulbous-thickened, perianth small, rather delicate, included; in the subgenus *Eucalyx*, perianth firm, much exserted, ovoid to obovoid-prismatic, 4–5-carinate and abruptly contracted to a short subtubular mucro at the mouth or carinae wanting and the apex conical and plicate, the superior bracts more or less adnate to perianth (or—more accurately, perhaps—borne on the excavated stem-apex). Calyptra free, surrounded at base by the unfertilized archegonia. Capsule globose-oval, dehiscing by straight rigid valves; cells bounding the inner surface of the valves with numerous semiannular thickenings, those of the outer surface with columnar or nodular thickenings; seta rather short or moderately long. Elaters bispiral.

Both of the species described below belong to the subgenus *Eucalyx*, which passes gradually into the genus *Jungermannia*. *Nardia crenulata*, in which the ♀ bracts are often only very slightly adherent to the base of the perianth, stands on the border line between *Nardia* and *Jungermannia* and would be about equally well at home in either group. *Nardia scalaris* (Schrad.) S. F. Gray, of the subgenus *Eunardia*, has been collected by Professor Macoun on Vancouver Island and may be expected to occur in California. This may be readily distinguished from either of the following species by the presence of lanceolate or subulate underleaves and by the conspicuous trigones of the leaf-cells; the perianth is included within the involucre formed by the bracts and bracteole.

* See footnote, p. 33.

Key to the Species.

Stems 3–8 mm. long, .15–.35 mm. in diameter, root-hairs colorless or yellowish; leaves .4–1.3 mm. long, usually broader than long, margined by enlarged cells or immarginate, slightly or not at all decurrent, median and superior leaf-cells 25–40 μ; ♀ bracts more or less adnate to perianth at its extreme base. 1. *N. crenulata.*

Stems 10–20 mm. long, .27–.64 mm. in diameter, root-hairs reddish-purple (occasionally decolorate); leaves .9–1.7 mm. long, usually longer than broad, mostly patent-horizontal and but slightly overlapping, obscurely if at all margined, decurrent, median and superior leaf-cells 32–60 μ; the inner ♀ bracts adnate to perianth for two thirds its length. 2. *N. obovata.*

1. NARDIA CRENULATA (Sm.) Lindb. Act. Soc. Sci. Fenn. **10**: 529. 1875.

Jungermannia crenulata Sm. Eng. Bot. *pl. 1463.* 1805. Hook. Brit. Jung. *pl. 37.* 1816.

Jungermannia gracillima Sm. Eng. Bot. *pl. 2238.* 1811.

Jungermannia crenulata gracillima Hook. Brit. Jung. *pl. 37.* 1816.

Jungermannia Genthiana Hüben. Hepaticol. Germ. 107. 1834.

Nardia gracillima Lindb. Act. Soc. Sci. Fenn. **10**: 530. 1875.

Nardia crenulata gracillima Lindb. Musc. Scand. 8. 1879.

Jungermannia rubra Gottsche; Underw. Bot. Gaz. **13**: 113. *pl. 4.* 1888. Bolander, Cal. Med. Gaz. 1870: 184 (40) (name only). 1870.

More or less red or brownish-red, very rarely green throughout, gregarious or forming thin compact mats: stems rather slender (.15–.35 mm. in diameter), 3–8 mm. long, prostrate, ascending at apex, simple or often sending out flagelliform latero-ventral branches; root-hairs numerous, moderately long, colorless or slightly yellow: leaves subcartilaginous, obliquely attached, slightly or not at all decurrent; those of the fertile stems usually crowded, subvertical, concave or nearly plane, broadly rounded-ovate or semiorbicular, .4–1.3 mm. long, .54–1.4 wide, entire or repand, in most cases distinctly margined by a single series of enlarged quadrate thick-walled cells, leaves of the sterile stems and flagella commonly distant, smaller, longer than broad, oval or elliptical, patent, often not at all or obscurely marginate; leaf-cells with walls weakly thickened at the angles, the superior and median 25–40 μ, the marginal often 2–3 times as large (in surface area) as the next adjacent; cuticle irregular and minutely hyaline-punctate: underleaves wanting or very rarely present in association with the ♀ bracts: dioicous: androecium terminal, ♂ bracts 3–10 pairs, concave, margined, suberect, imbricate; antheridia usually in pairs, globose,

.16–.2 mm. in diameter, short-stalked, accompanied by a few short paraphyses: ♀ bracts gradually larger than the leaves, more repand and commonly more conspicuously marginate, crowded and suberect or rather loosely disposed and spreading, the uppermost one or two more or less adnate to the base of the perianth or to the perigynial tube formed by the hollowed-out stem-apex, the very rarely occurring bracteole small, obovate, semiorbicular, or linguiform: perianth usually tinged with red or purple, nearly immersed or exserted ½–⅔ its length, subcomplanate-ovoid to narrowly obovoid or prismatic, 1.5–2 mm. long, .8–1.3 mm. in greatest width, nearly always, especially when young, distinctly quadrangular (rarely pentagonal), the angles often incrassate (of two layers of cells), the perianth wall otherwise unistratose except in the basal third or fourth, the mouth at first abruptly contracted into a very short subtubulose mucro, rather obscurely ciliolate-denticulate, at length lacerate: calyptra often reddish or purple, unistratose toward the apex, otherwise bistratose: capsule dark brown, ovoid, .7–.8 mm. in greatest diameter, the wall consisting of two layers of cells; seta 4–10 mm. long; spores brown, 13–16 μ, very minutely granulate; elaters brown, bispiral, attenuate at the extremities, contorted, 80–120 μ long, 8–13 μ in maximum width.

Exsicc. Hep. Am. 200.

On moist, usually exposed banks in the Coast Range Mountains, especially near the sea. Mendocino (Dr. H. N. Bolander); Santa Cruz (W. G. Farlow, May, 1885), Santa Cruz Mountains (L. M. Underwood, August, 1888); near Lake San Andreas, San Mateo Co.; Bolinas, Marin Co. (W. A. Setchell); near Cazadero, Sonoma Co.; Mendocino (582, 591, 620, 682); Eureka (902, 924).

The Californian forms mostly agree with Gottsche's *Jungermannia rubra*, founded on a specimen collected on "metamorphic sandstone, quite near the coast" at Mendocino by Dr. Bolander, but *Jungermannia rubra* seems to us not to differ in any essential structural characters from the European conditions of *Nardia crenulata* which have at times been known as *Jungermannia gracillima* and *J. Genthiana*. Leaves conspicuously margined by cells 2 or 3 times the size of the adjacent occur in the Californian specimens, though rarely. In general, the leaves here are only submarginate. But both Californian and European specimens show such extremes of variation in this particular in different parts of a single tuft or even in different parts of a single plant that this character cannot

be given much weight. The leaves are sometimes slightly more decurrent than we have observed them to be in European forms. The wall of the perianth is often two cells thick at the angles but we have never found the angles externally papillose-serrate.

2. NARDIA OBOVATA (Nees) Lindb. Bot. Notis. 1872: 167. 1872.

Jungermannia obovata Nees, Naturgesch. Eur. Leberm. 1: 332. 1833.

Southbya obovata Lindb. Hartm. Skand. Fl. 2: 130. 1871. [ed. 10.]

Bright green to brownish-red, loosely caespitose: stems rather stout (.27–.64 mm. in diameter), 1–2 cm. long, prostrate or ascending, simple or innovating above in fertile plants, very rarely otherwise branched; root-hairs abundant, long and fasciculate, reddish-purple or occasionally decolorate: leaves rather firm in texture, distant or slightly overlapping, the lower obliquely attached (at an angle of about 45°), patent-horizontal, the upper more transversely inserted, divergent and subsquarrose or somewhat erect, all orbicular-ovate from a narrowed, concave, sheathing base, plane, slightly concave or convex in the upper half, .9–1.7 mm × .7–1.5 mm, dorsally decurrent, entire or subrepand, the apex very obtusely or subtruncately rounded, rarely retuse; leaf-cells thin-walled, usually with small trigones, the sparse or moderately abundant chlorophyll-bodies finally disposed near the vertical (lateral) walls, median and superior cells 32–60 μ, the marginal often subquadrate or a little elongated radially and forming an obscure border, cuticle delicately striatulate-papillate: underleaves none: paroicous: antheridia in pairs, short-stalked, accompanied by a few short paraphyses, borne in the saccate bases of the lower ♀ bracts and adjacent leaves: ♀ bracts 4–6, larger than the leaves, obovate, erecto-patent, commonly reflexed at the apices, the superior 2–4 very highly adnate to the perianth, but not connate: perianth elongate-obovoid, free from the bracts only in the terminal third, the free portion scarcely projecting beyond the uppermost bracts or included, thin, composed of oblong, nearly hyaline cells, plicate toward the subentire or lobate mouth.

On the banks of a shaded slough, Blue Lake, Humboldt Co., June 3, 1896 (1002).

Nardia obovata has not before been recorded, we believe, for America, and as the above specimen is wholly sterile, its reference to this species is open to some question. With the exception of the color of the root-hairs—which show only very rarely a tinge

of reddish-purple—the agreement with European specimens of *Nardia obovata* is, however, so close that at least until more complete material is obtained we can do no better than to identify it with this species. In European specimens the root-hairs are sometimes colorless in certain parts of the stem, though we have never observed in these any such widely extended decoloration as in our Humboldt County plant. In regard to characters of leaves and leaf-cells, the correspondence between the Californian specimen and no. 870*a* of Jack, Leiner, and Stizenberger's Kryptogamen Badens is especially striking. The larger, more ovate, more distant, more patent-horizontal, and occasionally subsquarrose leaves stand in the way of referring the plant to *Nardia hyalina* (Lyell) Carr., while the firmer, subtruncately rounded, occasionally emarginate-retuse, decurrent leaves, and the more distinct trigones seem to preclude the possibility of its being any condition of *Jungermannia riparia* Tayl.

20. JUNGERMANNIA* L. *p. p.* (?) Sp. Pl. 1131. 1753. Ex Rupp. Fl. Jen. 345. 1718. Dumort. *p. p. max.* Rec. d' Obs. Jung. 16. 1835.

Jungermannia § *Aplozia* Dumort. *p. p. max.* Syll. Jung. 47. 1831.

Aplozia Dumort. *p. p. max.* Hep. Eur. 55. 1874.

Liochlaena Nees, G. L. & N. Syn. Hep. 150. 1845.

Jungermannia, subgenus *Eujungermannia* §1, Spruce, Trans. and Proc. Bot. Soc. Edinb. **15**: 508. 1885.

* Professor Schiffner (Eng. & Prantl, Nat. Pflanzenf. 1^3: 82. 1893) has discarded *Jungermannia* altogether as a generic name inasmuch as the *Jungermannia* of modern authors has come to bear little or no resemblance to the group recognized under this name by Linnaeus. *Jungermannia lanceolata* (*Liochlaena lanceolata* Nees) is the only representative of the Linnaean *Jungermannia* species of 1753 to be found in any recent conception of the genus and this same *Jungermannia lanceolata* of Linnaeus—if we are to interpret his species by the synonymy alone—was, according to Lindberg, a mixture of several species none of which was the *Jungermannia lanceolata* as known today, even though one or two of them did belong to the group "*Aplozia*." Dumortier in 1831 divided what was left of *Jungermannia*, after several excisions had been made, into nine sections, two of which were *Aplozia* and *Lophozia*. In 1835 he elevated *Lophozia* to generic rank, retaining the name *Jungermannia* for his former section *Aplozia*. None of the Linnaean specific names appeared under his *Lophozia* and none of the species recognized in the first edition of the Species Plantarum would have naturally found a place in this group. The Linnaean name *Jungermannia lanceolata*,

Plants mostly of medium size. Stems creeping or ascending, less commonly erect, simple or bearing a few latero-ventral branches, sometimes with one or two innovations from below the perianth; root-hairs usually long and moderately abundant. Leaves alternate, obliquely or almost longitudinally inserted and succubous, or transverse throughout, mostly patent-horizontal, rarely semivertical, oblong-elliptical, oblong-ovate, orbicular, or subreniform, never lobed, the margins very entire. Underleaves mostly wanting or small. Paroicous, dioicous, or autoicous. Androecium terminal or median, ♂ bracts ventricose, otherwise similar to the leaves, antheridia mostly 1–3, short-stalked, with or without paraphyses. Archegonia terminal on the main stem. ♀ bracts scarcely different from the leaves, distinct from each other and free from the perianth. Perianth ovoid, cylindrical, or clavate, plicate in the conical upper part or very abruptly contracted to a short tubular mouth, now and then somewhat compressed either laterally or dorso-ventrally. Calyptra free, surrounded at base by the sterile archegonia. Capsule oval or globose, dehiscing by straight valves; cells bounding the inner surface of the valves provided with semi-annular thickenings; seta long or somewhat short. Elaters bispiral.

Key to the Species.

Leaves decurrent.

Leaves very obliquely or almost longitudinally attached, mostly longer than broad. 1. *J. Bolanderi.*

Leaves transversely attached, clasping, mostly broader than long. 3. *J. Danicola.*

Leaves not decurrent, obliquely attached, elliptical-oblong. 2. *J. pumila.*

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which has now come to have a definite meaning, however much it may have covered at the start, was given a place under Dumortier's section *Aplozia*, which four years later became his genus *Jungermannia*. It therefore seems to us that, in the spirit at least of the unwritten "law of residues," the *Aplozia* group is the logical heir to the generic name *Jungermannia*. In 1874, however, Dumortier made an unfortunate and (according to our notions) an unjustifiable transposition of names by which *Jungermannia* was applied to his *Lophozia* of 1835 while his *Jungermannia* of 1835 was rechristened *Aplozia*; in this he has been recently followed by Massalongo, Evans, Heeg, Loitlesberger, and possibly others.

Relying upon a statement by Professor J. B Wilbrand (Flora, 9^2: 518. 1826) to the effect that "Ludovicus Jungerman" never wrote his name Jungerma*nn* but always Jungerma*n*, Lindberg, Spruce, Arnell, Underwood, Schiffner, Pearson, and many others have amended the original spelling of the generic name by omitting one of the n's. But M. Emile Bescherelle states (Journal de Botanique, 7: 191. 1893) that he has been informed by other botanists, among them Herr Stephani, that Jungermann wrote his name with a single *n* or with the two *n*'s. Under these circumstances, we agree with M. Bescherelle that it is better not to interfere with the spelling adopted by Ruppius, Micheli, and Linnaeus.

1. JUNGERMANNIA BOLANDERI Gottsche; Underw. Bot. Gaz. **13**: 113. *pl. 5.* 1888.

Pallescent, caespitose: stems 2–3 cm. long, .2–.35 mm. in diameter, prostrate or ascending (?), simple or with infrequent lateral branches, sometimes innovating below the first pair of ♀ bracts; root-hairs nearly obsolete, colorless or very dilutely yellow: leaves hyaline, rather soft, often flexuous or undulate, approximate or slightly succubous-imbricate or on the sterile shoots somewhat distant, very obliquely or almost longitudinally affixed to the stem, patent-horizontal, orbicular-ovate, .8–1.5 mm. long, .7–1.8 mm. wide, usually longer than broad, entire or lightly repand, somewhat concave dorsally with the dorsal margin more or less inflexed, those of the sterile stems nearly plane, all, especially the latter, strongly decurrent; superior leaf-cells 25–40 μ, the marginal not differentiated, the basal 45–96 μ, the thin walls scarcely or not at all thickened at the angles, cuticle smooth or slightly roughened: dioicous (?): ♀ bracts one or two pairs, wholly free from the perianth, the uppermost twice as large as the leaves, more concave, and more transversely inserted, otherwise similar: perianth cylindrical-obovoid, abruptly contracted when young to a small subentire or slightly denticulate subrostellate mouth, exhibiting finally 3–5 obtuse irregular folds in the superior half: antheridia and sporogonia unknown.

In ditches, Mt. Dana, altitude about 3100 meters (Dr. H. N. Bolander, September, 1866).

Jungermannia Bolanderi is evidently allied to *Jungermannia riparia* Tayl. and *J. pumila* With., yet is sufficiently distinct from either in the nearly rootless stems, the softer, strongly decurrent, almost longitudinally affixed leaves, and in the larger leaf-cells, of which the marginal show no (or extremely slight) tendency to be smaller than their neighbors and quadrate. The leaves are usually broadest below the middle, while in *Jungermannia pumila* they are usually broadest at just about the middle. Of perianths we have seen but two and these were apparently enclosing unfertilized archegonia and were thus probably not fully and perfectly developed. The larger of these was 1.4 mm. long and .8 mm. in greatest width, which was about the size of those seen by Dr. Gottsche, judging from his figures and his scale of magnification. The mouth in this was smaller, more nearly entire, and more abruptly contracted than in either *Jungermannia riparia* or *J. pumila* —was, in fact, almost liochlaenoid. Our description of the peri-

anth has been drawn in part from Gottsche's figures. Sterile plants bear some resemblance to *Nardia obovata* but differ in the almost entire absence of root-hairs, the softer, more decurrent, and much more longitudinally affixed leaves.

A type duplicate of *Jungermannia Bolanderi* from the hand of Dr. Gottsche, together with his original pencil sketches of the species, is preserved in the herbarium of Harvard University, which is true also of Dr. Gottsche's *Jungermannia Danicola*, *J. Müllcri Danaensis*, and *J. rubra*. We have made an effort to see the remainder of Dr. Gottsche's material of this and of his other Californian species, but without success. Dr. Gottsche's herbarium is in the possession of the Royal Botanical Museum at Berlin, but Dr. Hennings, in response to our inquiries, writes that the Gottsche collection is only partly arranged and that the Californian specimens desired cannot thus far be found.

2. JUNGERMANNIA PUMILA With. Arr. Brit. Pl. 3: 866. *pl. 18. f. 4.* 1796. [ed. 3.]*

Dark green, sometimes brownish or blackening, forming thin, loosely or closely interwoven mats: stems creeping, commonly ascending at apex, simple or sparingly branched, rhizomatous from the ventral surface or now and then innovating from the axils of the bracts; root-hairs usually long and numerous, colorless or yellowish-brown: the lower leaves loosely disposed, scarcely contiguous, obliquely affixed (line of attachment making an angle of about 45° with stem), patent-horizontal, less commonly semivertical, the upper closer, more transversely attached and more erect, all elliptical-oblong, .36–.9 × .27–.8 mm., obtuse, somewhat concave or nearly plane, entire or slightly repand, not decurrent; leaf-cells transparent, thin-walled, scarcely or not at all thickened at the angles, the median 18–35 μ, only a little enlarged toward the base, the marginal slightly smaller and subquadrate; cuticle finely striatulate or punctulate: underleaves none: paroicous: antheridia spherical, short-stalked, occurring singly in the axils of 2–4 pairs of saccate, clasping, suberect, more or less enlarged leaves, these functioning also as ♀ bracts: perianth narrowly cylindrical-obovoid, 1.2–2.5 × .36–1 mm., somewhat plicate in the terminal half or third and rather gradually narrowed to a small slightly hyaline-denticulate mouth.

On moist rocks, stones in brooks, etc.

* We have been unable to see the third edition of Withering's work.

The occurrence in California of this widely distributed species cannot be considered as demonstrated beyond the possibility of a doubt. It is inserted here on the strength of the existence in Professor Underwood's collection of a specimen from the Roy Herbarium labeled "Bolander, Sept., 1866," without indication of locality. From such an inscription it is natural to infer that Bolander was the collector. Dr. Bolander was upon Mt. Dana early in September, 1866, and according to his journal, for an extract from which we are indebted to Dr. W. L. Jepson, seems to have spent the remainder of the month in San Francisco. Another specimen, however, from the Roy Herbarium, so identical with the former even in its algal associates as to make it practically certain that the two grew in the same tuft, is labeled "Near McLeod's Lake, B. C., J. Macoun, 26 June, 1875." A similar plant, though apparently dioicous and having larger, more ovate leaves, has been collected since that date by Professor Macoun in several localities in British Columbia.

3. JUNGERMANNIA DANICOLA Gottsche; Underw. Bot. Gaz. **13**: 113. *pl. 3.* 1888.

Fuscous-brown, caespitose: stems prostrate-entangled, 6–10 mm. long, .18–.36 mm. (in attenuate conditions only .08–.1 mm.) in diameter, simple, sparingly dichotomous, or emitting a few lateral branches, sometimes innovating from near the base of perianth; root-hairs very long, colorless or tawny, commonly wanting toward the stem-apex and on the more slender stems and innovations, otherwise moderately abundant: leaves somewhat distant or contiguous, slightly overlapping and a little larger toward apex of stem, patent or patent-horizontal, transversely inserted, concave, embracing more than one half the stem, decurrent, entire, those of the fertile stems broadly orbicular to subreniform, .5–.9 mm. long, .65–1.2 mm. wide, those of the attenuate sterile stems smaller, orbicular or broadly ovate; superior and median leaf-cells 24–50 μ, the walls with small trigonal thickenings at the angles, chloroplasts and oil bodies rather few, the marginal cells slightly smaller but scarcely differentiated in form or color, cuticle nearly smooth or sometimes very minutely hyaline-papillate: underleaves none: monoicous (paroicous ?): antheridia in pairs, short-stalked, in the axils of hardly modified stem-leaves somewhat removed from the ♀ bracts, which are similar to the leaves though more erect: perianth finally obovoid, exserted, irregularly plicate toward the some-

what abruptly contracted, at first crenulate-denticulate mouth: sporogonium unknown.

In ditches, Mt. Dana, alt. about 3100 m. (Dr. Henry N. Bolander, September, 1866).

Jungermannia Danicola is very closely allied to the *Jungermannia amplexicaulis* Dumort. (*J. tersa* Nees) of Europe. It differs, however, in several more or less significant particulars and had best be considered distinct, at least until better known. We have been unable to find either perianth or antheridia in that portion of the type material preserved in the Gray Herbarium, and have drawn our brief description of these parts from Dr. Gottsche's figures. What we have seen of the original material consists mostly of slender and distant-leaved sterile shoots; these, judging from the stouter stems which sometimes occur and which Dr. Gottsche sketched, probably do not fairly represent the species. From *Jungermannia amplexicaulis*, the Mt. Dana plant seems to differ in the dark brown color, the smaller size, the apparently prostrate (possibly ascending) stems, the smaller rather more distant, more translucent leaves, and the less differentiated marginal cells. The two antheridia figured by Dr. Gottsche occupy the axil of the fourth leaf below the perianth, counting on one side only. *Jungermannia amplexicaulis* (*J. tersa*) is described by Nees, Limpricht, and Stephani as dioicous, but Lindberg (Kongl. Sv. Vet. Akad. Handl. **23**[5]: 39. 1889) states that it is paroicous. As represented in Jack, Leiner, and Stizenberger, Kryptogamen Badens, no. 873 *b* and *c*, the species is certainly paroicous, it being not difficult to demonstrate collapsed antheridia with their still persistent stalks, intermingled with a few paraphyses of various forms, in the slightly saccate bases of the ♀ bracts. In Gottsche and Rabenhorst, Hep. Eur. nos. 359 and 511, we find paraphyses in the axils of the ♀ bracts, but detect no unquestionable antheridial remains. The occurrence of antheridia in the position figured by Gottsche in *Jungermannia Danicola* suggests the possibility that they may occur also nearer the archegonia.

The perianth of *Jungermannia amplexicaulis* is when young rather abruptly contracted at the apex to form a small subtubulose mouth. Dr. Gottsche's figure of a very young perianth of *J. Danicola* shows no appreciable contraction but it would appear that this

surrounds immature archegonia, when the contraction would naturally be less than at a little later period in the development of the perianth; however, we suspect that there may be some difference in this regard between *Jungermannia Danicola* and *J. amplexicaulis*.

From *Jungermannia sphaerocarpa* Hook. (including *J. lurida* Dumort. and *J. nana* Nees), *Jungermannia Danicola* appears to be distinct in the transversely inserted, proportionally broader, more concave, more clasping, and more spreading leaves.

21. LOPHOZIA Dumort. *p. p. max.* Rec. d'Obs. Jung. 17. 1835. Schiffn.; Engler & Prantl, Nat. Pflanzenfam. I³: 84. 1893.

Gymnocolea Dumort. *p. p., l. c.*

Diplophyllum Dumort. *p. p., l. c.*, 15.

Jungermannia § *Lophozia* Dumort. *p. p. max.* Syll. Jung. 53. 1831.

Jungermannia Dumort. Hep. Eur. 68. 1874. And of nearly all authors.

Plants small to very robust. Stems creeping or ascending, simple, dichotomous, or with a few latero-ventral branches, often innovating from near the base of the perianth; root-hairs usually numerous. Leaves alternate, succubous, or transversely inserted, with 2–5 (commonly acute) teeth or lobes, plane or more often dorsally concave, sometimes complicate-bilobed but never acutely carinate; walls of the leaf-cells thin or with trigones at the angles, never pitted or nodulose. Underleaves wanting or when present mostly small, lanceolate-subulate and entire, or bifid, or ciliate-fringed. Androecium terminal or median; ♂ bracts sometimes with an additional tooth or lobe on the dorsal margin near the ventricose base, antheridia 1–9 (commonly 1–3), mostly short-stalked, with or without paraphyses. Archegonia terminal on the main stem. ♀ bracts distinct, free, usually somewhat different from the leaves, often with more lobes, and sometimes dentate-margined. Perianth oval, cylindrical, or cylindric-obovoid, plicate above the middle or sometimes only obscurely at the very mouth, the apex obtuse, or more commonly conical, or in some species abruptly contracted to a small tubulose mucro at the mouth. Calyptra free. Capsule subglobose to elongate-ovoid, dehiscing by four straight rigid valves, these usually composed of three layers of cells, the inner with semiannular thickenings. Elaters bispiral.

Key to the Species.

Underleaves present (usually inconspicuous). 3. *L. heterocolpa.*

Underleaves wanting (unless in association with ♀ bracts).

Leaves bilobed to below the middle, complicate, transversely inserted; the dorsal lobe lanceolate, suberect or ascending; the ventral lobe ovate or oblong-ovate, patent-horizontal. 5. *L. ovata.*

Lobing or cleavage of the leaves not extending below the middle.

Leaves unequally 2–5-lobed ⅓–½ their length, the lobes acutely and in most cases spinescently pointed, the margins more or less spinulose-dentate; median leaf-cells 30–60 μ. 1. *L. incisa.*

Leaves 2- (rarely 3-) lobed ½–⅔ their length, close or approximate, the lobes acute, occasionally apiculate, rarely subobtuse, entire, the sinus broad; median leaf-cells 24–32 μ. 2. *L. ventricosa.*

Leaves 2-lobed ¼–⅓ their length, usually distant or merely approximate, the lobes obtuse, entire, the sinus rather narrow. 4. *L. inflata.*

1. LOPHOZIA INCISA (Schrad.) Dumort. Rec. d'Obs. Jung. 17. 1835.

Jungermannia incisa Schrad. Syst. Samml. Krypt. Gew. **2**: 5. 1797. Schrad. Jour. Bot. 1801: 67. 1803. Hook. Brit. Jung. *pl. 10.* 1816.

Light green or darkening, densely and intricately caespitose or widely depressed-gregarious: stems very short and thick (4–6 mm. × .27–1.1 mm.), ascending, simple, once furcate, or sending out one or two lateral branches toward the apex; root-hairs numerous, long, colorless: leaves usually close, commonly crowded at stem-apex, plicate-crispate, succulent, almost transversely inserted or somewhat oblique and succubous, subcomplicate, erecto-patent, subquadrate or ovate-oblong, .7–1.8 mm. × .5–1.7 mm., deeply (⅓–½) and unequally 2–5-lobed, the lobes triangular-ovate, acutely and in most cases spinescently pointed, their margins usually reflexed and, especially in the larger ventral lobes, more or less spinulose-dentate, sinuses acute or rounded; leaf-cells quadrate-hexagonal, becoming oblong toward the base, the median 30–60 μ, thin-walled, with rather small though distinct trigones, the abundant chloroplasts and small oil-bodies usually aggregated near the middle of the cell, cuticle smooth; gemmae frequent, mostly in clusters at the tips of the leaf-lobes, irregularly tetrahedral or cubico-sphaeroidal, uniseptate: lanceolate or subulate underleaves sometimes present in association with the ♀ bracts, otherwise wholly wanting: dioicous: ♂ bracts closely crowded together toward stem-apex, scarcely different from the ordinary leaves; antheridia single or in pairs, subglobose, .18–.2 mm. in diameter, on very short pedicels, paraphyses none: ♀ bracts a little larger than the leaves, broader than long, deeply 3–5-cleft, more abundantly dentate and more

strongly crisped: perianth oval to elongate-obovoid, 2–3.5 mm. × .9–1.5 mm., bistratose at base, the plicate mouth ciliate-dentate: seta 5–12 mm. long; capsule subglobose, reddish-brown, .7–1 mm. in diameter, the valves thick and rigid, of three layers of cells, the walls of the cells of the inner layers provided with very numerous annular or semiannular thickenings, those of the external layer with similar but much less perfect fibers; spores cinnamon-brown, 13–15 μ, minutely granulate-papillate; elaters fusiform, 80–145 μ long, 8–10 μ in greatest width, somewhat geniculate.

On logs or decaying wood in moist places. Sisson, Siskiyou Co. (40, 41); near Mendocino (672); near Eureka (962).

All our Californian specimens with the exception of no. 41 are sterile and gemmiferous, with the leaves mostly 2-, less commonly 3-lobed, otherwise subentire, the lobes, with rare exceptions, merely acute. Our no. 40, with leaves of this character, was once (Erythea, 4: 49. 1896) erroneously referred to *Jungermannia ventricosa* Dicks., from which it may be readily distinguished by the more deeply and unequally lobed and more complicate leaves, the smaller dorsal lobe being often inclined forward somewhat parallel to the stem, and by the larger, thinner-walled leaf-cells.

Our description of the sporogonium has been drawn from a Montana specimen collected by Mr. R. S. Williams and from European material.

2. LOPHOZIA VENTRICOSA (Dicks.) Dumort. Rec. d'Obs. Jung. 17. 1835.

Jungermannia ventricosa Dicks. Pl. Crypt. **2**: 14. 1790. Hook. Brit. Jung. *pl. 28.* 1816.

Jungermannia porphyroleuca Nees, Naturgesch. Eur. Leberm. **2**: 78. 1836.

Yellowish-green, sometimes reddish-brown or subfuscous, densely caespitose: stems .5–1.5 cm. long, prostrate or ascending, sparingly branched, often reddish underneath, the numerous root-hairs mostly colorless and rather short: leaves close or approximate, obliquely inserted or almost transverse toward the apex, semivertical or spreading, slightly concave, now and then (especially the superior) canaliculate or obtusely subcomplicate, often soft and somewhat flaccid, ovate-quadrate, 2- (rarely 3-) lobed, the sinus broad, mostly rounded-obtuse, occasionally gibbous, descending $\frac{1}{5}$–$\frac{2}{3}$ the length of the leaf, lobes acute, occasionally apiculate, rarely subobtuse, often erose through the formation of gemmae,

these marginal or more commonly in clusters at the apices of the lobes, irregular, somewhat tetrahedral or subcubical, mostly uniseptate; median leaf-cells rounded-hexagonal, 24–32 μ, trigones distinct but variable in size, the cuticle smooth or slightly roughened: subulate or broader and bifid underleaves usually present in association with the ♀ bracts and sometimes on young "subfloral" innovations, otherwise wholly wanting: dioicous: androecia terminal, oval; ♂ bracts imbricate, transversely inserted, obtusely subcomplicate, ventricose; antheridia in pairs or single, oval, .12–.18 mm. in greatest diameter, on short stalks composed of a single row of cells, accompanied by a few short paraphyses: ♀ bracts somewhat larger than the leaves, the inmost deeply and unequally 2–5- (mostly 3- or 4-) lobed, often slightly plicate, the lobes acute or subobtuse: perianth cylindrical-obovoid, 2–3 mm. long, 1–1.5 mm. in greatest width, unistratose except at extreme base, the plicate mouth ciliolate-denticulate: calyptra mostly bistratose: seta 10–15 mm. long; capsule-valves purplish- or yellowish-brown, .9–1.1 mm. long, of three layers of cells, the inner with close annular or semiannular fibers, the outer with nodular or imperfect semiannular thickenings; spores yellowish- or reddish-brown, finely granulate-papillate, 12–14 μ; elaters fusiform, subobtuse, 80–130 μ × 8–10 μ.

On soil in moist places and on decaying wood. Mt. Dana at about 3100 m. alt., associated with *Lophozia heterocolpa*, *Jungermannia Danicola*, and *J. Bolanderi* (Dr. H. N. Bolander, September, 1866); between Farewell Gap and Mineral King, Tulare Co., alt. 3500 m. (Coville and Funston, Death Valley Expedition, no. 1573, Aug. 10, 1891); beside "Horse Camp Spring," above timberline, Mt. Shasta, alt. (est.) about 3100 m. (Howe, August, 1894).

These three high-altitude specimens, the second ♂ and the others sterile, seem clearly to fall in the form-cycle of *Lophozia ventricosa*, agreeing essentially with the soft-leaved terricolous conditions of this species from other parts of the world, as represented, for example, in Carr. and Pears. Brit. Hep. no. 171. The plants grow in densely compacted tufts, and the walls of the leaf-cells, in the last two specimens especially, are but slightly thickened at the angles save in the more exposed parts. Lindberg and Arnell (Kongl. Sv. Vet. Akad. Handl. **23**[5]: 50. 1889) would restrict the application of the specific name *ventricosa* to forms with poorly developed trigones, but Lindenberg (Syn. Hep. Eur. 86. 1829), who, it would appear, had examined original Dicksonian speci-

mens, affirms that these agree with his form *conferta* characterized partly by a "*textura firma*," instead of the "*contextu laxiore*" of the form *laxa*, which possibly indicates that the form with well developed trigones should be considered typical.

The leaves of the Mt. Shasta plant have a rather unusually pronounced tendency toward being complicate, but this feature is observable now and then in specimens from other localities. The form or variety inhabiting chiefly decaying logs and stumps (*J. porphyroleuca* Nees) is to be expected to occur in California, particularly, perhaps, in the northern coast counties.

We have observed in North American specimens of *Lophozia ventricosa* the two kinds of coloration of the capsule noted by Limpricht (Cohn, Krypt.-Fl. Schles. 1: 280, 281. 1877), but cannot determine that this character stands in any constant relation to other characters which have been supposed by some to distinguish *Jungermannia porphyroleuca* from *J. ventricosa*. In Austin's Hep. Bor.-Am. no. 36, for instance, the purplish-brown or "violet-red-brown" capsules occur on gametophytes which exhibit leaf-cells with the strongly developed trigones and roughened cuticle supposedly characteristic of *J. porphyroleuca*.

It is extremely doubtful if the original of *Jungermannia ventricosa* exists in Dickson's Herbarium in the British Museum. Two scraps are, however, to be found there, under which is written, in pencil, in what is said to be Dickson's hand,

"bid^ta With. ed. 3
ventricosa"

But these belong to the genus *Lophocolea*. The leaves of these, with the exception of the younger, are considerably *less* deeply cleft than those in the figures of Micheli and Dillenius which Dickson cites, and in allusion to which he remarks: "Folia in nostra profundius fissa, quam in figuris Michelii et Dillenii depinguntur." A young trigonous-prismatic perianth, twice as long as broad—which Dickson probably could not have described by "*vagina sphaeroidea*"—is present on one of the scraps. The reference to the third edition of Withering would indicate that the inscription under these specimens was written at least six years after the original publication of *Jungermannia ventricosa*.

3. LOPHOZIA HETEROCOLPA (Thed.)

Jungermannia heterocolpa Thed. Kongl. Sv. Vet. Acad. Handl. 1838: 52, 72. *pl. 1.* 1839. [As *J. heterocolpos.*]

Jungermannia Mülleri heterocolpos G. L. & N. Syn. Hep. 99. 1844.

Jungermannia Wattiana Aust. Bull. Torr. Bot. Club, 3: 11. 1872.

Jungermannia Mülleri Danaensis Gottsche; Underw. Bot. Gaz. 13: 114. *pl. 6.* 1888.

Yellowish- or lurid-green, densely caespitose or creeping among mosses: stems 6–15 mm. long, .12–.3 mm. thick, prostrate or ascending, sparingly ramose, the ♀ commonly continued through the development of an innovation from underneath the perianth, the median innovation sometimes accompanied by one or two lateral; root-hairs numerous, long, colorless: leaves close or approximate, obliquely inserted, patent or sometimes subvertical toward the stem-apex, usually firm in texture, rarely somewhat soft and flaccid, not decurrent, orbicular-ovate or subquadrate-elliptical, .36–1 mm. × .35–.8 mm., the superior usually somewhat concave dorsally, the inferior more or less arcuate-convex, all emarginate-bilobed $\frac{1}{6}$–$\frac{1}{3}$ their length, the acute or obtuse sinus commonly gibbous-recurved, the lobes obtuse, rarely subtriangular-acutate, those of the inferior leaves often slightly arcuate-recurved; marginal and superior leaf-cells 16–32 μ (mostly 20–25 μ), trigones well developed (6–11 μ), the cuticle with very obscure hyaline roughenings: underleaves small, lanceolate-subulate and subentire or bifid and sometimes sparingly dentate at base: gemmae frequent, brown, subglobose-ellipsoidal, uniseptate, 24–30 μ × 16–24 μ, borne on the apices of much modified, larger-celled, 3-ranked leaves, these erect-imbricate in a more or less elongated terminal spike: dioicous: ♂ bracts unidentate on dorsal margin; antheridia paired, on very short stalks: ♀ bracts gradually a little larger than the leaves and sometimes with repand margins, otherwise similar: perianth ovoid to obovoid-oblong, 1.5–2 mm. × .9–1.2 mm., often apparently dorsal owing to the early development of a strong hypogynous innovation, somewhat laterally compressed in the upper half when young, the small mouth minutely denticulate.

In ditches, Mt. Dana, alt. about 3100 m. (Dr. H. N. Bolander, September, 1866); Fish Creek, Mariposa Co. (Miss Edith S. Byxbee, July, 1895).

In the description of *Jungermannia Mülleri Danaensis* (*l. c.*), it

is stated that "amphigastria" are wanting, but an examination of the specimen sent by Dr. Gottsche to the Gray Herbarium discloses underleaves of the *J. Mülleri-heterocolpa* type more or less concealed by the root-hairs, and Dr. Gottsche had evidently intended to represent these in his camera-lucida tracings, especially in the figures published by Professor Underwood (*l. c.*) under Nos. V., IX., X., XII., and XV. The leaf-cells of the Mt. Dana material are mostly less strongly collenchymatous than those of Scandinavian specimens of *Lophozia heterocolpa* that we have examined, yet portions of this same material show all the transitions to trigones of the normal size. The plant collected by Miss Byxbee has larger leaf-cells, together with larger trigones, and in this respect makes an approach to *Jungermannia Mülleri* Nees, but differs from that species in the usually obtuse leaf-lobes, in the ♀ bracts being entire (except for the median cleft) or merely repand, in the ovoid or obovoid-oblong perianth, which is not at all rostellate, and in the presence of transformed spicate gemmiparous leaves. The perianths in this specimen are nearly all falsely dorsal. In the original diagnosis of *Jungermannia heterocolpa*, Thedenius writes "*fructu terminali* (*rarius pseudoalari*)" and his figure shows a terminal perianth. We have seen but one European perianth-bearing specimen of *J. heterocolpa*, which we owe to the kindness of Dr. H. W. Arnell; in this about one fourth of the perianths have become falsely dorsal or lateral. In this, too, the perianths have only about two thirds of the length assigned to the perianths of the species of Lindberg (Kongl. Sv. Vet. Akad. Handl. **23**[5]: 43. 1889), agreeing closely in this respect with the American forms.

Inasmuch as Limpricht (Cohn, Krypt.-Fl. Schles. **1**: 276. 1877) has remarked that an apparent original of *Jungermannia Bantriensis* Hook. (found in Herb. v. Flotow, with the legend, "J. bantriensis N. v. E. Irland, Herb. Hook.! dd. N. ab. E.") is the gemmiferous ♂ plant of *Jungermannia Mülleri* and as Lindberg (Kongl. Sv. Vet. Akad. Handl. **23**[5]: 43. 1889) has observed that the gemmiparous forms of *J. Mülleri* of authors ought probably to be referred to *J. heterocolpa*, we have made an effort to examine the Hookerian material of *J. Bantriensis*. In response to an inquiry addressed to Sir W. T. Thiselton-Dyer, as to whether

the original specimen of Hooker's *Jungermannia Bantriensis*, collected by Miss Hutchins at Bantry, Ireland, was still preserved at Kew, we received the following statement: "There is no specimen of this at Kew marked, 'Bantry, Miss Hutchins.' But on a specimen not localized is written (I believe in Wilson's handwriting): 'This is probably the specimen mentioned in Brit. Jung^{ae}. See note to description of *J. stipulacea*.' The note referred to contains the diagnosis of *J. Bantriensis*. A portion of this specimen is enclosed." This specimen proves to be *Harpanthus Flotovianus* Nees. It is readily distinguishable from any of the *Lophozia Mülleri-heterocolpa* alliance by the decurrent leaves, the wholly smooth cuticle, the larger underleaves, and the short ventral ♀ branches, which here bear unfertilized archegonia; some of the stems are gemmiparous at the apex, but the gemmiparous leaves are not transformed in any such way as in *Lophozia heterocolpa*. A comparison of this specimen with Hooker's figure and description precludes the possibility of its being the desired original.

To the friendly generosity of Mr. W. H. Pearson, we owe the privilege of examining a specimen marked "Jung. Bantriensis Hook. Bantry. Coll. Miss Hutchins, Nov. 19, 1812. *Original*." This specimen, though sterile, we can easily believe to have been a part of the original material studied by Hooker. It agrees essentially with *Jungermannia Hornschuchiana* Nees as represented in Rab. Hep. Eur. 128, differing chiefly in the slightly smaller leaf-cells and the more prominently verruculose-striolate or granulate-papillate cuticle. From *Lophozia heterocolpa* it differs in the larger (about 1.5 mm. wide) flaccid decurrent leaves, which are bidentate rather than bilobed, the usually acute teeth being separated by a broad, shallow sinus, in the larger leaf-cells (marginal and superior 28–50 μ), in the very distinctly roughened cuticle, and in the absence of gemmae.

4. LOPHOZIA INFLATA (Huds.)

Jungermannia inflata Huds. Fl. Angl. 511. 1778 [ed. 2].

Gymnocolea inflata Dumort. Rec. d'Obs. Jung. 17. 1835.

Green, yellowish-brown, or sometimes blackening, with (especially in the darker forms) a somewhat oleaginous lustre, usually forming soft closely interwoven mats: stems prostrate, ascending, or occasionally erect, 6–20 mm. long, .09–.25 mm. in diameter,

mostly weak and slender, sparingly subdichotomous, or with a few lateral or latero-ventral branches, often innovating from near the base of the perianth ; root-hairs short, scanty, colorless or yellowish: leaves usually distant or contiguous, obliquely inserted, patent-horizontal to erecto-patent, now and then reflexed, orbicular-ovate to subquadrate-oblong, .36–.9 mm. × .27–.8 mm., somewhat decurrent dorsally, concave or nearly plane, bilobed ¼–⅓ their length, the sinus rather narrow, more or less obtuse, the margin otherwise entire or slightly repand, lobes obtuse, nearly parallel, rarely inclined toward each other or subdivergent, the dorsal a little the smaller; leaf-cells rather thick-walled, with indistinct trigones, the superior and median 24–40 μ, the basal scarcely larger, cuticle smooth or obscurely striolate: underleaves wanting unless in association with the ♀ bracts: dioicous: androecium terminal or median, ♂ bracts imbricate, concave, mostly broader than long, almost transversely inserted ; antheridia ovoid, .2 mm. in greatest diameter, on very short stalks, unaccompanied by paraphyses: ♀ bracts often a little smaller than the leaves, otherwise similar: perianth much exserted, sometimes exposed to the extreme base or even appearing stipitate, now and then falsely dorsal through the development of a "subfloral" innovation, prolate-ellipsoidal or elongate-pyriform, 2–2.7 mm. × .85–1.2 mm., inflated, smooth throughout or obscurely plicate only at the obtuse apex, the wall bistratose in the basal third or fourth, the mouth with a few short connivent teeth: capsule elongate-ovoid, its wall of three layers of cells, the external layer with nodular or columnar thickenings, the others with semiannular ; spores 14–18 μ, granulate-papillate, elaters contorted, slightly attenuate at extremities, 120–180 μ long, 8–10 μ in maximum width.

In swamps, on wet rocks, etc.

"Mt. Dana, Cal., legit H. N. Bolander" in herb. Underwood. The specimen is wholly sterile, but we feel no doubt as to its identity with the above species.

5. LOPHOZIA OVATA (Dicks.)

Jungermannia ovata Dicks. Pl. Crypt. Brit. 3: 11. *pl. 8. f. 6.* 1793.

Jungermannia Dicksoni Hook. Brit. Jung. *pl. 48.* 1816.

Diplophyllum Dicksoni Dumort. Rec. d'Obs. Jung. 16. 1835.

Diplophylleia Dicksoni Trevis. Mem. r. Ist. Lomb. III. 4: 420. 1877.

Bright green above, darker below, caespitose, often in compact extended mats; stems 8–20 mm. long, simple or dichotomously

branched, prostrate-entangled or slightly ascending, rather rigid, beset with long root-hairs almost to the apex: leaves transversely inserted, of nearly uniform size throughout, .5–.9 mm. long, not decurrent, bilobed to below the middle ($\frac{3}{5}$–$\frac{2}{3}$) with an acute sinus, complicate, the fold nearly a right angle but rounded; lobes of about equal length, acuminate, obscurely crenulate towards the apex, the dorsal narrower, lanceolate, suberect or ascending, somewhat parallel to the stem, the ventral ovate or oblong-ovate, patent-horizontal (75°–80°), submarginate toward the base; leaf-cells opaque, firm-walled, with small trigones, hexagonal-quadrate, 17–24 μ, more elongated at base, cuticle minutely roughened: underleaves none: antheridia 1 or 2, subglobose, without paraphyses, on short pedicels in the axils of closer somewhat ventricose leaves with appressed imbricate dorsal lobes: ♀ bracts larger than the leaves, long-acuminate, sparingly dentate; perianth oval or oblong, 2–3 times length of the involucral leaves, deeply plicate, the mouth ciliate-lacinulate.

EXSICC. Hep. Am. 193 (as *Diplophylleia Dicksoni*).

On the face of a shaded cliff near Cazadero, Sonoma Co., on the road to Fort Ross (Mar. 14, 1896). Collected also by Dr. Bolander at Mendocino City. These are the only American stations thus far known for this hepatic. Our specimens are sterile or bear antheridia alone, so that the species is presumably dioicous. The description of involucre and perianth is drawn from Husnot's Hep. Gall. no. 29. The leaves are rarely three-lobed in the Californian plants as also in the European.

The identification of Dickson's *Jungermannia ovata "e specimine auctoris"* was first made by Lindberg (Musc. Scand. 7. 1879). Mr. A. Gepp of the British Museum has kindly at our request examined the specimen of *J. ovata* Dicks. in the Dickson herbarium and confirms the determination of Lindberg. Mr. Gepp writes: "Our specimen of *J. ovata* Dicks. is labeled *ovata* by Dickson, and, so far as the arrangement of the specimens goes, it is the undoubted type of the species."

The rounded, instead of acutely carinate, fold of the leaf sufficiently removes the species from the genus *Diplophylleia* and places it in the *Sphenolobus* section of *Lophozia*.

22. PLAGIOCHILA Dumort. Rec. d'Obs. Jung. 14. 1835.
Martinellius S. F. Gray *p. p.* Nat. Arr. Brit. Pl. 1: 690. 1821.
Radula Dumort. *p. p.* Comm. Bot. 112. 1822.

Radula § *Plagiochila* Dumort. *p. p.* Syll. Jung. 42. 1831.

Plants usually large. The primary stems creeping, radiculose, nearly leafless, rhizome-like; secondary stems foliose, commonly ascending or suberect, stout, rufous or dark-brown, rarely pallid, mostly destitute of root-hairs, simple or dichotomously branched, less commonly pinnate, often subdendroid. Leaves large, succubous, in most species alternate, plano-distichous or deflexed, sometimes secund, decurrent dorsally and more or less ventrally, unsymmetrical; the apex mostly rounded or truncate, dentate or spinose, rarely entire; the dorsal margin nearly straight or slightly concave, recurved, especially toward the base, in most cases subentire; ventral margin arcuate, plane or decurved at the base, dentate or spinose, very rarely entire; leaf-cells generally medium-sized or rather large, with distinct trigones. Underleaves wanting or occurring only toward the stem-apex or sometimes present throughout, small or minute, entire or irregularly bi–multi-fid. Androecium spicate, terminal or median; ♂ bracts smaller than the leaves, transversely inserted, closely imbricate, their bases erect, ventricose-saccate, the basal margins highly adnate to the stem; antheridia 1–10. Archegonia very numerous, terminal on the main (secondary) stem or the branches. ♀ bracts distinct, free, usually differing but little from the leaves, somewhat larger and more strongly toothed. Perianth exserted, strongly compressed laterally (at least when young), with a more or less winged suture dorsally and sometimes also ventrally, campanulate or obconic-cylindrical, the wide mouth usually obliquely truncate, often bilabiate, the lips dentate-spinose or ciliate-fringed. Calyptra free, included. Capsule globose-oval, dehiscing to the base by four straight sometimes bifid valves, these composed of several layers of cells, cells bounding the inner surface provided with numerous semiannular bands; seta rarely more than twice the length of the perianth. Elaters bispiral.

1. PLAGIOCHILA ASPLENIOIDES (L.) Dumort. Rec. d'Obs. Jung. 14. 1835. Lindenb. Spec. Hep. (*Plagiochila*), 110. *pl. 23.* 1839 (?).

Jungermannia asplenioides L. Sp. Pl. 1131. 1753. Hook. Brit. Jung. *pl. 13.* 1816.

Jungermannia porelloides Torrey; Nees, Naturgesch. Eur. Leberm. 1: 169. 1833.

Plagiochila porelloides Lindenb. Spec. Hep. (*Plagiochila*), 61. *pl. 12.* 1839 (?).

Densely caespitose or scattered among mosses, pale green or darkening: secondary stems ascending or erect, mostly 1–10 cm.

long, simple, dichotomous or with a few lateral branches, light brown, nearly or quite devoid of root-hairs: leaves alternate, subimbricate, patent-horizontal to erecto-patent, deflexed, orbicular-obovate to obovate-oblong, 1.5–4 mm. long, 1.2–3 mm. in greatest width, the dorsal margin strongly reflexed, the ventral margin decurved and, like the rounded or broadly obtuse apex, dentate or subciliate, or sometimes entire; superior and median leaf-cells 24–48 μ, all with rather small, though distinct, trigones: underleaves usually present, minute, .15–.3 mm. long, lanceolate-subulate and entire or often reduced to a small cluster of capillary filaments: dioicous: androecium terminal or median; ♂ bracts 4–8 pairs, their apices spreading or squarrose; antheridia 1–3, on stalks about equaling their long diameter: ♀ bracts scarcely different from the leaves: perianth obconic-oblong, mostly 4–6 mm. long, 1.6–2.2 in greatest width, sometimes falsely lateral through the development of an innovation, compressed and somewhat twisted toward the bilabiate, ciliate-dentate or denticulate mouth: seta 15–30 mm. long; elaters 140–200 μ long, somewhat tapering at the ends, 9–14 μ in maximum width; spores 16–20 μ, minutely punctulate.

On rocks, soil, and logs, in moist woods. Blue Lake (1005, ♂) and Deer Creek Cañon, Russ & Graham's Ranch (1064, *c. per.*), Humboldt Co. Measurements of spores and elaters are drawn from G. & R. Hep. Eur. 620.

23. LOPHOCOLEA Dumort. Rec. d'Obs. Jung. 17. 1835.

Jungermannia § *Lophocolea* Dumort. Syll. Jung. 59. 1831.

Plants usually moderately large, rarely small, soft and flaccid, mostly yellowish-green or pallescent, forming rather thin effuse mats or repent-spreading. Stems creeping, subsimple or irregularly ramose, the branches lateral or latero-ventral, those bearing the sexual organs sometimes ventral; root-hairs in tufts at the base of the underleaves, colorless, commonly long. Leaves alternate or (in exotic species) often opposite, succubous, decurrent dorsally, for the most part obliquely oblong-ovate, often somewhat triangular, occasionally subquadrate, truncate or more commonly bidentate or bifid at apex, with broad or narrow sinus, the margins otherwise very entire or (in extra-limital species) now and then serrulate, spinose, or ciliate-fringed; leaf-cells usually rather large or medium-sized, thin-walled, occasionally with small trigones at the angles. Underleaves present throughout, cuneiform, ovate, or subquadrate in general outline, in our species deeply bi- or quadrifid with subulate, mostly diverging segments. Dioicous, autoicous, or paroicous. Androecium occupying the end or middle of a

branch; ♂ bracts several pairs, commonly smaller than the leaves, more erect and imbricate, with an incurved lobule at the saccate base, antheridia large, usually solitary. Archegonia numerous, terminal on the main stem or on somewhat elongated branches. ♀ bracts usually somewhat larger than the leaves, often more deeply bifid or more dentate. Perianth exserted, triangular-prismatic, at least when young, with the third angle always dorsal, mostly 2–4 times longer than broad, 3-lobed at the wide mouth, the lobes rarely somewhat truncate and entire, usually bifid and more or less ciliate-dentate or spinose. Calyptra free, thin, shorter than the perianth. Capsule ellipsoid-oval, dehiscing to the base by straight rigid valves; capsule wall of several layers of cells, those of the external layer thick, with columnar or imperfectly semiannular thickenings, those of the inner layers thin, the inmost with numerous semiannular bands; seta long. Elaters bispiral.

Key to the Species.

Leaves all bidentate or bifid, with long subulate-acuminate teeth or segments; autoicous. 1. *L. cuspidata.*

Upper leaves merely retuse, or entire and truncate; paroicous. 2. *L. heterophylla.*

1. LOPHOCOLEA CUSPIDATA (Nees) Limpr.; Cohn, Krypt.-Fl. Schles. 1: 303. 1877.

Lophocolea bidentata cuspidata Nees, Naturgesch. Eur. Leberm. 2: 327. 1836.

Pallid-green, closely caespitose or repent-spreading: stems 6–20 mm. long, .15–.27 mm. in diameter, bearing (especially the fertile) frequent diverging lateral branches, occasionally dichotomous; root-hairs few or moderately abundant: leaves ovate to oblong-ovate, .63–1.6 mm. × .45–1.3 mm., almost equally narrowed to the apex on both sides, bidentate with a broad crescentic sinus or on the more slender branches sometimes bifid ⅓ their length with a rather narrow subobtuse sinus, segments (or teeth) long, subulate-acuminate, subequal and mostly parallel; leaf-cells usually pellucid, somewhat incrassate, the superior and median 24–48 μ, thin-walled, trigones minute or wanting, cuticle smooth: underleaves patent, often only bifid and extrorsely unidentate on either side, or the subulate, commonly divergent, principal segments again bifid: autoicous; antheridia and archegonia borne in most cases on more or less elongated ventral or latero-ventral branches: androecium terminal, rarely median; ♂ bracts somewhat similar to the leaves or smaller, less acutely lobed, and more imbricate, saccate dorsally at the base, the inflexed margin commonly provided with one or two teeth or lobes; antheridia mostly

single, subglobose, .25–.3 mm. in diameter, the very short stalk of a single row of cells: ♀ branches 2–10 mm. long (archegonia sometimes apparently terminal on the main stem), leaves increasing in size upward, becoming more erect and crowded and, like the ♀ bracts, externally canaliculate-concave; ♀ bracts bifid ⅓–½ their length, otherwise usually entire, bracteole similar, almost equally large: perianth longer than the bracts, triangular-prismatic, 2–3.5 mm. × .8–1.3 mm., 3-lobed ¼–½ its length, the lobes usually bifid and often sparingly dentate: capsule dark-brown, 1–1.2 mm. × .65–.72 mm.; spores 16–24 μ, minutely punctulate; elaters contorted, somewhat attenuate at the extremities, 160–220 μ long, 9–12 μ in maximum width.

On decaying sticks, logs, and stumps, in moist woods, rarely on moss-covered trunks of living trees. Not uncommon in the Coast Range Mountains from Marin County northward. Often with perianths, yet rarely with capsules. Olema (27), Marin Co.; North Fork of the Little River (631, 635, 653) and Mendocino (697), Mendocino Co.; Eureka (901) and Blue Lake (988), Humboldt Co.

Lophocolea Leibergii Underwood and Cook, Hep. Am. no. 70 (without diagnosis) cannot, we think, be safely distinguished from the above species.

2. LOPHOCOLEA HETEROPHYLLA (Schrad.) Dumort. Rec. d' Obs. Jung. 17. 1835.

Jungermannia heterophylla Schrad.; Schrad. Jour. Bot. 1801: 66. 1803. Hook. Brit. Jung. *pl. 31.* 1816.

Yellowish-green, caespitose or repent-spreading: stems 5–20 mm. long, .15–.27 mm. in diameter, closely creeping, usually with frequent lateral branches, root-hairs numerous: leaves ovate to subquadrate-oblong, .54–1.3 mm. ×.4–1 mm., very obliquely or almost longitudinally inserted, semivertical, dimorphous, the lower obtusely, or sometimes acutely, bidentate or bilobed, with a rounded-obtuse sinus, the upper retuse, or entire and truncate; superior and median leaf-cells 24–48 μ, the thin walls with distinct trigones at the angles, cuticle nearly smooth: underleaves usually appressed, bifid to below the middle, the subulate-acuminate segments each commonly furnished externally with a single tooth or short cilium: paroicous, rarely heteroicous: ♂ bracts 3–5 pairs immediately below the archegonia or perianth, the uppermost functioning also as ♀ bracts, almost transversely inserted, close, erect-appressed with commonly squarrose apices, truncate or retuse, dorsally ventricose at base with one or two inflexed lobules

or teeth, androecia rarely occurring also at a distance from the archegonia either on the same axis or on special branches; antheridia globose, about .27 mm. in diameter, the short stalk of a single series of cells: ♀ bracts a little larger than the subjacent perigonial leaves, otherwise similar; bracteole deeply bifid with lanceolate-subulate segments: perianth terminal on a more or less elongated latero-ventral branch, longer than the bracts, cylindrical or somewhat goblet-shaped, 1.3–3.2 mm. × .63–1.3 mm., 3-angled toward the mouth and 3-lobed $\frac{1}{6}$–$\frac{1}{3}$ its length, the lobes subtruncate, rarely acute, repand-dentate: capsule brown, 1–1.2 mm. × .75–1 mm.; spores 12–16 μ, minutely punctulate; elaters contorted, slightly attenuate at the extremities, 110–210 μ long, 8–11 μ in greatest width.

On moldering wood (logs, stumps, etc.) in moist cañons, occuring rarely on moist soil in which there is considerable vegetable matter. "Redwood Cañon" (near Mill Valley) and Olema, Marin Co.; Turner's Cañon (between Cazadero and Fort Ross), Sonoma Co.; Big River Boom (near Mendocino, 684), North Fork of the Little River (695), and near "Half-Way House" (726), Mendocino Co.; Eureka (919, 950, 952, 1220), Humboldt Co.

No. 695 was found in a rivulet, apparently of only periodic duration, in "The Plains," North Fork of the Little River, the substratum being sand mixed with vegetable remains. The plants, in this case, are wholly sterile, yet they seem to belong with *Lophocolea heterophylla*, though their habit of growth is more densely caespitose and the leaves are often more acutely bidentate than is usual. All our other Californian specimens occur upon dead wood.

24. CHILOSCYPHUS Corda [as *Cheilocyphos*]; Opiz, Beitr. 651. 1829.*

Vegetative characters of the genus as a whole agreeing very closely with those of *Lophocolea*. Leaves more often entire. Archegonia terminal on a very short ventral or latero-ventral branch. ♀ bracts 1 or 2 pairs, the outer pair (if present) minute, the inner always considerably smaller than the leaves. Perianth usually campanulate or obconical, 3-angled only toward the 3-lobed mouth. Calyptra carnose, especially in the lower part, shorter than the perianth or often much exserted. Sporogonium essentially as in *Lophocolea*.

* See footnote, p. 33.

1. CHILOSCYPHUS POLYANTHOS (L.) Corda; Opiz, Beitr. 651. 1829.*

Jungermannia polyanthos L. Sp. Pl. 1131. 1753. Hook. Brit. Jung. *pl. 62.* 1816.

Jungermannia pallescens Schrad. Syst. Samml. Krypt. Gew. **2**: 7. 1797.

Chiloscyphus pallescens Dumort. Syll. Jung. 67. 1831.

Chiloscyphus lophocoleoides Nees, Naturgesch. Eur. Leberm. **2**: 365. 1836.

Green or pallescent, closely or laxly caespitose: stems 1–3 cm. long, .18–.45 mm. in diameter, prostrate or ascending, sparingly branched, root-hairs conspicuous or nearly obsolete: leaves close-imbricate or approximate, patent-horizontal, spreading in the plane of the stem or, toward the stem-apex, ascending or semivertical, quadrate-orbicular to oblong, .7–1.6 mm. × .54–1.2 mm., more or less concave ventrally, the apex rounded, subtruncate, or retuse; leaf-cells translucent, the superior and median 32–65 μ; the walls somewhat thickened, yet exhibiting obscure trigones or none at all, cuticle slightly granulate or nearly smooth: underleaves oblong-ovate, bifid to the middle or below, the segments often linear-subulate, occasionally bearing a single tooth or short cilium externally; autoicous; androecium terminal or median on the main stem, ♂ bracts with small dorsal pouches, otherwise similar to the leaves, the margin of the pouch usually with several short inflexed cilia; antheridia single or less commonly in pairs, subglobose, .14–.2 mm. in diameter, the very short stalk composed of a single row of cells; axis of ♀ branch .3–.6 mm. long; ♀ bracts a single pair, with sometimes rudiments of a second (outer) pair, very much smaller than the leaves, retuse or bifid, bracteole minute, bifid; perianth goblet-shaped or obovoid, 2–2.7 mm. long, .9–1.6 mm. in greatest width, deeply 3-lobed, the lobes subtruncate and nearly entire, rarely spinose-dentate: calyptra exserted or included: capsule brown, globose-oval, 1.2–1.5 mm. × 1.1–1.4 mm., the valves rigid, of 4 or 5 layers of cells, those of the external layer thick, with columnar or imperfectly semiannular thickenings, those of the inmost layer with very numerous semiannular bands; spores 14–20 μ, minutely granulate; elaters 120–200 μ × 8–11 μ.

On old logs and on moist ground among mosses. "Paper Mill Creek" [Marin Co.?] (Dr. H. N. Bolander, Sept. 9, 1863); Sisson, Siskiyou Co. (Howe, 37); near Hay Fork, Trinity Co. (1125); North Fork of the Little River (636) and near Mendocino

* See footnote under *Ricciocarpus*, page 33.

(683), Mendocino Co.; Big Valley Mts. and White Horse Lake, Modoc Co. (M. S. Baker and F. P. Nutting).

In our only specimens with sporogonia (Big Valley Mts., Baker and Nutting), the calyptra is included within the perianth or but slightly exserted. The ♀ branches in this originate a little to one side of the middle line of the ventral surface of the stem and are no more strictly ventral than in *Lophocolea cuspidata*. When sterile, there is a possibility of confusing the species with *Lophocolea heterophylla*, but the more entire leaves with larger leaf-cells and usual absence of trigones and the simpler underleaves are commonly distinctive. Antheridia can be found in most specimens and their distribution along the back of the main stem in smaller, more dorsal pouches of otherwise scarcely modified leaves is also characteristic.

1*b*. CHILOSCYPHUS POLYANTHOS RIVULARIS (Schrad.) Nees, Naturgesch. Eur. Leberm. **2**: 374. 1836.

Jungermannia pallescens rivularis Schrad. Syst. Samml. Krypt. Gew. **2**: 7. 1797.

Jungermannia aquatica Schrank (?), Bai. Fl. **2**: 496. 1789.

Aquatic, usually larger in all parts, dark green, with a somewhat fatty lustre: stems 1.5–10 cm. long, more ramose: leaves sometimes broader than long (now and then 2–2.5 mm. broad), mostly rounded at apex; leaf-cells opaque, the superior and median 24–50 μ: underleaves destroyed or wanting except in the youngest parts: always (?) sterile.

EXSICC. Hep. Am. 92.

In running water or on the banks of streams. "California" (Bolander); Cazadero, Sonoma Co.; Navarro (Miss Byxbee), North Fork of the Little River (613), Mendocino Co.; Eureka (956) and Russ & Graham's Ranch (1085), Humboldt Co.; near Douglas City (1143), Trinity Co.; Sisson (35), Siskiyou Co.; Dixey Valley and Bridge Creek, Lassen Co. (Baker & Nutting); Lake Tahoe (W. C. Blasdale, 1897); region of the Yosemite (C. M. Cooke, Jr., 1896).

The variety *rivularis* is often very different from the pale, large- and translucent-celled, wood-inhabiting condition of the species, yet the two appear to be connected by riparian forms. Our Sisson specimen, distributed in Hep. Am. as no. 92, differs considerably

in general aspect from the usual form of the var. *rivularis* owing to the proportionally broader leaves which, in drying, are commonly semivertical or somewhat wrapped around the stem. This grew in very cold swiftly running water.

Jungermannia aquatica Schrank is sometimes quoted as a synonym of *Chiloscyphus polyanthos rivularis*. If a true synonym, the name *aquatica* would replace *rivularis*, according to the provisions of the Rochester Code. But, personally, we are not fully convinced that *Jungermannia aquatica* Schrank is really such a synonym. Schrank's description would, perhaps, on the whole, apply equally well to *Jungermannia cordifolia* Hook.

25. GEOCALYX * Nees, Naturgesch. Eur. Leberm. **1**: 97, 102. 1833. *Et op. cit.* **2**: 395. 1836.

Calypogia Dumort. Syll. Jung. 73. 1831. Not *Calypogeja* Raddi, Atti Soc. Ital. Sci. Mod. **18**:—(33). 1818.

Saccogyna Lindb. *p. p.* Not. Sällsk. Fauna et Flora Fenn. Förhandl. **13**: 377. 1874. Act. Soc. Sci. Fenn. **10**: 509. 1875. Schiffn. *p. p.* Eng. & Prantl, Nat. Pflanzenfam. **I**^{3}: 93. 1893.

Plants resembling in habit *Lophocolea* and *Chiloscyphus*. Stems creeping, simple, or with a few branches, these springing from the axils of the underleaves or latero-ventral; root-hairs usually few, mostly from near the bases of the underleaves. Leaves alternate, succubous, bidentate or bilobed, slightly decurrent dorsally. Underleaves present throughout, much smaller than the leaves, bifid to the middle or below, free or connate with the leaf-base on one side by a very narrow isthmus. Androecium on a short branch from the axil of an underleaf, ♂ bracts considerably smaller than the leaves, unequally and for the most part acuminately bilobed, with an additional tooth or lobule on the dorsal margin; antheridia single or less commonly in pairs, short-stalked, without paraphyses. Archegonia few, terminal on a very short branch springing from the axil of an underleaf, the branch in its further development becoming a fleshy pendulous subterranean sac (perigynium) enclosing the young sporogonium and bearing about its mouth a few inconspicuous scale-like ♀ bracts, these often destroyed on the exsertion of the capsule. Perianth wanting. Calyptra shorter

* The differences in vegetative characters between *Geocalyx graveolens* and *Saccogyna viticulosa* are so striking that we feel unwilling to follow Lindberg, Carrington, Schiffner, Bescherelle, and Kaalaas in reducing *Geocalyx* to *Saccogyna*—at least until we have had an opportunity of examining the exotic species which are said to hold an intermediate position.

than the perigynial tube, with which it is coalesced for two thirds its length, the unfertilized archegonia (1, 2, or 0) situated near the base of the free portion. Capsule nearly cylindrical, dehiscing to the base by straight valves, these composed of two layers of cells, the cells of the outer layer with inconspicuous columnar or nodular thickenings, those of the inner layer with semiannular bands; seta moderately long; involucellum short, goblet-shaped, finally surrounding the base of the seta. Elaters bispiral.

1. GEOCALYX GRAVEOLENS (Schrad.) Nees, Naturgesch. Eur. Leberm. **1**: 98. 1833. *Et op. cit.* **2**: 397. 1836.

Jungermannia graveolens Schrad. Syst. Samml. Krypt. Gew. **2**: 6. 1797.

Saccogyna graveolens Lindb. Act. Soc. Sci. Fenn. **10**:. 509. 1875.

Bright or olive-green, caespitose: stems 6–20 mm. long, .22–.3 mm. in diameter: leaves plano-distichous, less commonly semivertical, imbricate or approximate, rather rigid, subquadrate-ovate, .8–1.4 mm. × .55–1 mm., bidentate or bilobed $\frac{1}{6}$–$\frac{1}{4}$ (rarely $\frac{1}{3}$) their length, the lobes acute or now and then somewhat obtuse, parallel or sometimes slightly connivent, the sinuses rounded or subacute; leaf-cells 24–48 μ, scarcely enlarged toward the base, thin-walled with small trigones, the numerous chloroplasts commonly arranged in a ring leaving a clear area in the middle and often a hyaline peripheral border; cuticle finely granulate-papillate: underleaves appressed, bifid to below the middle, the lobes lanceolate, entire, nearly parallel: autoicous: ♂ branch .3–1.2 mm. long: ♀ bracts 4 or 5: perigynium cylindrical, about 2.5–3 mm. × 1 mm., its entire outer surface sparingly radiculose: capsule 1–1.6 mm. × .5–.63 mm.; seta 8–20 mm. long; spores 11–16 μ, slightly granulate-papillate; elaters 110–200 μ × 9–14 μ, somewhat obtuse.

On a charred stump of *Sequoia sempervirens*, Eureka, May 31, 1896 (no. 938). The species occurs also on moist soil and rocks. Our single Californian specimen bears a few perigynia and dehisced capsules, but we have not observed ♂ branches upon it with any certainty.

26. CEPHALOZIA Dumort. *p. p. max.* Rec. d'Obs. Jung. 18. 1835.

Jungermannia § *Cephalozia* Dumort. *p. p. max.* Syll. Jung. 60. 1831.

Nowellia Mitt.; Godman, Nat. Hist. Açores, 321. 1870. Schiffn.; Eng. & Prantl, Nat. Pflanzenfam. I^3: 97. 1895.

Eucephalozia Schiffn. *l. c.*

Prinolobus Schiffn. *p. p.*; Eng. & Prantl, Nat. Pflanzenfam. I^3: 98. 1895.

Cephaloziella Schiffn. *l. c.*

Green, whitish, brown, olivaceous, or sometimes tinged with rose-color, small, medium-sized, or minute, depressed-caespitose or creeping among mosses. Stems leafy throughout or rhizomatous at base, or, in some species, flagelliferous, subramose, the branches, with rare exceptions, arising ventrally, root-hairs numerous or scanty. Gemmae occurring in a few species, borne on stem-apex or leaf-margins. Leaves alternate, succubous and sometimes almost horizontal, more rarely nearly transverse, rather broad, more or less concave, bifid from one third to more than one half their length, often subcomplicate, the lobes triangular-ovate, lanceolate, or subulate, sometimes connivent, the margins plane or slightly incurved, never recurved, entire in most, in a very few denticulate or sharply serrate-dentate; leaf-cells from rather large and pellucid to minute and subopaque, the walls thin in most of the species, thickened in a few, especially toward the angles, cuticle smooth or somewhat roughened. Underleaves much smaller than the lateral and often entire, wholly wanting in most species except in the ♀ involucre where they are always represented and often nearly or quite equal the bracts in size. Dioicous, autoicous, or polyoicous, very rarely paroicous. Androecium subamentiform, median or more rarely terminal, sometimes occupying an entire branch; perigonial leaves often a little larger or smaller than the ordinary, more concave and more crowded, sometimes with a small accessory incurved lobule on the dorsal margin; antheridia solitary. Archegonia several or numerous, terminal on a much shortened or sometimes elongated branch or less commonly on the main stem. Bracts free from the perianth, crowded, considerably larger than the leaves, 3-ranked (including bracteoles), usually in three sets, 2–4-lobed, often dentate or incised; inmost bracteole always present, similar to the corresponding bracts and often more or less highly connate with them on one or both sides, the outer bracteoles commonly somewhat smaller, rarely wanting. Perianth more or less highly emersed, 2–7 times longer than broad, distinctly trigonous, at least when young, with one angle always ventral, or sometimes 4–6-angled, its wall of one layer of cells or, in some species, 2- or 3- stratose toward the base, commonly constricted at the denticulate, ciliate, laciniate, or subentire mouth. Calyptra small, thin, or rarely

fleshy, surrounded at the base by the sterile archegonia. Capsule long-exserted on a very delicate pellucid seta, cylindrical-oblong, or oblong-globose, quadrivalvular to the base, the walls bistratose, cells of the inner layer with semiannular thickenings. Elaters bispiral, deciduous, subobtuse, mostly 150–200 μ long and 8–10 μ wide. Spores smooth or minutely roughened, about 8–10 μ.

Key to the Species.

Leaf-cells 30–60 μ.

Leaves bifid to the middle or a little below, longer than broad; perianth-wall unistratose unless at extreme base. 1. *C. bicuspidata.*

Leaves bifid about ⅓ their length, commonly as broad as long or broader; perianth-wall of 2 or 3 layers of cells for ⅙–⅔ its length.

Dioicous; leaves .18–4 mm. in diameter, decurrent, nearly horizontal or subassurgent. 3. *C. media.*

Monoicous (polyoicous?); leaves .3–.55 mm. in diameter, scarcely or not at all decurrent, assurgent or vertical-connivent. 2. *C. pleniceps.*

Leaf-cells 10–20 μ.

Ramification ventral; leaves distant or subimbricate, their lobes usually very entire and often divergent. 4. *C. divaricata.*

Ramification commonly lateral; leaves mostly approximate, often crowded and equitant, complicate-bilobed, the margins sharply and unequally serrate-dentate. 5. *C. Turneri.*

1. CEPHALOZIA BICUSPIDATA (L.) Dumort. Rec. d'Obs. Jung. 18. 1835.

Jungermannia bicuspidata L. Sp. Pl. 1132. 1753. Hook. Brit. Jung. *pl. 11.* 1816.

Jungermannia Lammersiana Hüben. Flora, **15**: 306. 1832.

Jungermannia extensa Tayl. Lond. Jour. Bot. **5**: 279. 1846.

Cephalozia extensa Spruce, On Cephalozia, 44. 1882.

Eucephalozia bicuspidata Schiffn.; Eng. & Prantl, Nat. Pflanzenfam. 1^3: 97. 1895.

Greenish or pallid, more rarely rufescent or tinged with rose-color, prostrate or assurgent-caespitose, often flagelliferous: stems rather sparingly branched, 4–20 mm. long, nearly terete, 6 or 7 cells in diameter, the cortical cells large and pellucid, the interior much narrower: leaves orbicular-ovate, sometimes oblong-ovate, mostly .3–.65 mm. long, obliquely attached or subtransverse, the inferior distant or approximate, the superior commonly large and subimbricate or crowded, all bifid ½–⅘ their length, concave, often subcomplicate, the sinus obtuse, lobes ovate-lanceolate, triangular-lanceolate, or subtriangular, connivent or patent, subacuminate or the ventral merely acute, sometimes—especially the dorsal—attenuate to an apiculus 2–4 cells in length; leaf-cells rather large,

thin-walled, pellucid, somewhat thick, quadrate-hexagonal, becoming elongated toward base, 30–60 μ; underleaves usually wanting except in association with the ♀ bracts: polyoicous: androecium median, terminal, or occupying an entire branch, the perigonial leaves much like the others but more concave, usually closer, and sometimes with a small accessory tooth on the dorsal margin near the base: archegonia terminal on a very short or much elongated branch: bracts about three pairs; the inmost 2–3 times longer than the leaves, sometimes slightly connate at the base, bifid to the middle, the lobes mostly lanceolate-acuminate, entire, repand, or with one or two teeth near the base; bracteole similar: perianth linear-subfusiform, thrice longer than the bracts, 1.8–2.5 mm. × .5 mm., at first tricarinate-prismatic, later often becoming nearly terete below, remaining trigonous toward the constricted denticulate or setulose mouth, its wall unistratose throughout unless at the extreme base: calyptra thin: capsule cylindrical-oblong, .6–.75 mm. × .3–.4 mm.; spores purple.

On decaying wood, moist soil, and in swamps among mosses.

Mendocino (Dr. Bolander; Howe, 719) and North Fork of the Little River (610, 615, 652, 659, 661, 689), Mendocino Co.; near Eureka (916, 963, 1031).

An examination of *Jungermannia extensa* Tayl. from "Observatory Inlet, N. America, Dr. Scouler, 1834" in the Taylor collection, now incorporated in the Gray Herbarium, Cambridge, Mass., shows, we think, no satisfactory and reliable grounds for its separation from *C. bicuspidata*. Spruce (On Cephalozia, 45) emphasizes only the "cladogenous perichaetia" as distinguishing it from *C. Lammersiana*, but we find the ♀ branches in the original material often much elongated as in *C. Lammersiana;* flagella are not wholly wanting; the leaves are commonly bifid to below the middle, but they can be matched in this respect by European specimens as also in respect to the apiculus of the leaf-lobes. Most of the Californian specimens are dioicous and agree closely with the original of Taylor's *Jungermannia extensa*.

The specimens which we once reported (Erythea, **4**: 50. 1896) from California under the name *Cephalozia bicuspidata* belong with *C. media* but have somewhat thinner perianths than is normal with that species.

2. CEPHALOZIA PLENICEPS (Aust.) Lindb. Medd. Soc. Faun. et Fl. Fenn. 9: 158. 1883.

Jungermannia pleniceps Aust. Proc. Acad. Nat. Sci. Philad. 1869: 222. 1869.

Cephalozia crassiflora Spruce, On Cephalozia, 40. 1882.

Pale green, sometimes lightly tinged with brown, densely caespitose, now and then suberect and forming compact cushions: stem subramose, rather stout, about 8 cells in diameter, flattened dorsally, the cortical cells large and pellucid; branches occasionally stoloniform: leaves obliquely orbicular, mostly .3–.55 mm. in diameter, strongly concave, assurgent, often vertical-connivent, subimbricate, more rarely distant, scarcely or not at all decurrent, bifid about one third their length, the sinus obtuse, less commonly acute, the lobes acute or the ventral occasionally subobtuse, often more or less connivent; leaf-cells quadrate-hexagonal, becoming oblong-hexagonal toward the base, rather large and thick, pellucid, thin-walled, 30–60 μ: rudimentary underleaves rarely present toward the apex of the younger branches: monoicous (polyoicous?): androecium median or terminal, dorsal lobe of perigonial leaves commonly with an incurved tooth or lobule near its base: ♀ branch very short or somewhat elongated; the inmost bracts bi- to quadri-fid, distinct or slightly connate with each other and with the bracteole, often bistratose at the base, the segments acute; bracteole usually bi–tri-fid; perianth cylindrical-oblong, 2.3–2.8 mm. × .6–.9 mm., contracted at the plicate, denticulate mouth, carnose, of three layers of cells at the base and bistratose to the middle or even for two thirds its length; calyptra mostly unistratose.

On the ground beside a stream, near Sisson, Siskiyou Co., growing among Musci (*Aulacomnium*, etc.) and forming a compact turf.

The type specimen, from the White Mountains of New Hampshire (legit Oakes) is in the possession of Mr. W. H. Pearson.

The Californian plant has a rather narrower and more fleshy perianth than the original, the wall of this organ being in the former bistratose for two thirds its length, in the latter only about to the middle. *Cephalozia crassiflora* Spruce—from the Pyrenees—an authentic specimen of which, also, we have seen in herb. Pearson, seems to differ from the original *C. pleniceps* in scarcely anything but in having the perianth widest above the middle, while in both the New Hampshire and California plants the perianth is com-

monly widest at the middle or a little below. We are of the opinion, first ventured as a suspicion by Dr. Spruce (On Cephalozia, 41) and afterwards confirmed by Mr. Pearson (List of Canadian Hepaticae, 9) that *Cephalozia crassiflora* is a synonym of *C. pleniceps*.

We have here some grounds for believing that our Californian specimen is dioicous as well as monoicous but the branches of a *Cephalozia* can be so easily disarticulated in manipulation that we dare not assert this with positiveness.

Cephalozia pleniceps can be distinguished from its near ally *C. media* by the twice larger, scarcely or not at all decurrent, more nearly orbicular and less rhomboidal leaves, which incline to be vertical-connivent instead of horizontal or subassurgent, by the broader, merely acute lobes, the thinner calyptra, the rather more fleshy perianth, etc. This species seems always to be found in company with mosses in swamps, beside streams, and on moist rocks, while *C. media*, in California at least, affects logs and decaying wood almost exclusively.

PLATE 104. CEPHALOZIA PLENICEPS.

1. Portion of plant showing perianth and androecium, × 12.
2. Portion of a sterile stem, with leaves, × 23.
3. ♀ branch showing perianth and bracts, dorsal view, × 12.
4. The same, ventral view, × 12.
5. Another ♀ branch, with perianth and bracts, dorsal view, × 12.
6. ♀ branch, lateral view, the perianth undeveloped, × 23.
7. A thin longitudinal microtome section of perianth, × 23.
8–11. Cauline leaves, showing the outer (convex) face, × 23.
12–14. Bracts, × 23.
15. Bracteole, × 23.
16. Second (next to the inmost) bracteole, × 23.
17. Portion of perianth mouth, × 41.
18. Cross-section of stem, × 53.
19–21. Bases of bracts with adjacent parts of stem, in sectional view, × 41.
22. A cauline leaf, × 41.

Figs. 2–4 and 12–17 from the original specimen collected in the White Mts. of New Hampshire by Mr Oakes, ex herb. Pearson; the remaining figures from our specimen collected at Sisson.

3. CEPHALOZIA MEDIA Lindb. Medd. Soc. Faun. et Fl. Fenn. **6**: 242. 1881.

C. multiflora Spruce, On Cephalozia, 37. 1882.

Eucephalozia media Schiffn.; Eng. & Prantl, Nat. Pflanzenfam. I^3: 97. 1895.

Slender, bright- or pallid-green, prostrate, forming close depressed mats or rarely laxly creeping, rather sparingly and irregularly ramose, the apices often ascending: stem somewhat flattened dorsally, the cortical cells large and pellucid: leaves small, orbicular-rhomboidal, .18–.4 mm. in diameter, subimbricate and somewhat assurgent or often distant and nearly horizontal, decurrent dorsally, bifid about one third their length with an obtuse or rarely lunate sinus and connivent, acute or subacuminate lobes; leaf-cells pellucid, 30–45 μ: dioicous: androecia occupying the end, rarely the middle of mostly rather short branches: inmost bracts of the very short ♀ branch about three times larger than the outer, orbicular-oblong, bi–quadri-fid, the segments acute or acuminate, entire; bracteole nearly similar, sometimes connate with the bracts: perianth oblong- to linear-fusiform, 1.5–2.4 mm. × .4–.8 mm., constricted and denticulate at the mouth, of 2 or 3 layers of cells toward the base, sometimes 2-stratose as high as the middle, the remainder unistratose; calyptra 2- or 3-stratose throughout: capsule cylindrical-oblong, .6–.8 mm. × .28–.5 mm.; spores cinnamon colored.

On decaying logs in moist shaded places, rarely on the ground. Common in the Coast Range Mountains, north of San Francisco.

Redwood Cañon near Mill Valley, and near Olema (28), Marin Co.; Duncan's Mills and Turner's Cañon, Sonoma Co.; Navarro (Miss Byxbee), North Fork of the Little River (656), Mendocino (572, 573, 598, 665, 674), Half-Way House (725), Mendocino Co.; Eureka (904, 949), Humboldt Co.; near Hay Fork, Trinity Co. (1124); Sisson, Siskiyou Co. Collected in Marin Co. also by Professor Underwood and said to have been found in California also by Dr. Bolander.

The perianth in our specimens is usually of a thinner texture than is ascribed to *Cephalozia multiflora* by Dr. Spruce. It is rarely that the perianth-wall is 2-stratose so far as the middle. In most cases the perianth-wall is of more than one layer of cells only in the lower third or fourth, sometimes even only in the basal sixth, yet we have been able to discover no other character to distinguish the Californian plant from the European and an examination of European specimens seems to indicate that this character is susceptible to some variation even there.

4. CEPHALOZIA DIVARICATA (Sm.) Dumort. Hep. Europ. 89. 1874.

Jungermannia divaricata Sm. Eng. Bot. *pl. 719.* 1800.

Jungermannia Starkii Funck ; Nees, Naturgesch. Eur. Leberm. 2 : 215, 225. 1836.

Cephaloziella divaricata Schiffn. ; Eng. & Prantl, Nat. Pflanzenfam. I^3 : 99. 1895.

Very small, green, olivaceous, or nearly black, sometimes tinged with rose-color, closely caespitose or laxly creeping among mosses, prostrate or ascending, eflagelliferous ; stem stout for the size of the plant, 2–10 mm. long, sparingly branched, about 7 or 8 cells in thickness, the cortical in 14–22 series, not different from the interior or a little smaller, root-hairs often rather abundant : leaves small, scarcely longer than the diameter of the stem or twice as long, subquadrate or rotund-quadrate, .08–.18 mm. in length, .08–.2 mm. in width, distant or subimbricate, nearly transverse, bifid to the middle or a little below, the lobes triangular-ovate, acute, subacuminate, or nearly obtuse, divergent or subcomplicate, entire, slightly repand, or now and then with a single small tooth on one side or the other ; leaf-cells subquadrate, minute, 10–16 μ, subopaque or pellucid, the walls thin or somewhat thickened especially at the angles, cuticle smooth or minutely granulate ; stem-apex and margins of the apical leaves sometimes gemmiferous : underleaves wanting, or present in the younger parts, entire and subulate or lanceolate, or sometimes broader and emarginate or bifid : dioicous : androecium terminal or median, cauline or rameal, the perigonial leaves in several pairs, concave, appressed-imbricate, commonly a little larger than the ordinary leaves, less deeply and more acutely lobed : archegonia terminal on the main stem or on an elongated branch : bracts in three pairs, 2 or 3 times larger than the leaves, bilobed or rarely trilobed, usually distinct dorsally but commonly highly connate with the bracteole, the lobes acute or acuminate, denticulate, subspinulose, or nearly entire, often hyaline at the apex ; bracteole similar, outer bracteoles two, somewhat smaller than the corresponding bracts and less deeply cleft ; perianth fusiform-ovoid to linear, .8–1.4 mm. × .2–.4 mm., prismatic, 3–6-angled, mostly hyaline toward the apex and sometimes purplish below, somewhat contracted at the denticulate or subentire mouth, the wall unistratose.

On logs, charred stumps, rocks, and moist soil, commonly associated with mosses and other hepatics.

Frequent in the Coast Range region. Clarendon Heights, San Francisco ; Mill Valley, Mt. Tamalpais, and Lake Lagunitas, Marin Co.; Cazadero, Sonoma Co.; Mendocino (544, 619, 669), North Fork of the Little River, and Ukiah (741), Mendocino Co.; Eureka (956) and Blue Lake (995), Humboldt Co.; Mt. Diablo,

Contra Costa Co.; Fruit Vale, Alameda Co. (Miss Edith S. Byxbee). Also gathered by Dr. Bolander.

In the Californian specimens, underleaves can nearly always be detected toward the apex of the younger stems or branches.

4*b*. **Cephalozia divaricata scabra** var. nov.

Leaves mostly opaque, often of two or three layers of cells at base, especially near the median line, the back near the fold usually papillate, verrucose, spinulose-dentate, subciliate, almost lamelligerous, or subradicelliferous, the margins now and then subdenticulate or at the base even spinulose-dentate, the lobes sometimes apiculate, cuticle of the leaf-cells distinctly roughened: stems exhibiting rarely here and there minute paraphyllia-like appendages, usually composed of 2 or 3 cells in a lineal series: perianth-wall often bistratose in the basal fourth or fifth.

On rocks. Near Hay Fork (1110), Trinity Co.; Doolan's Cañon (776), near Ukiah, Mendocino Co.; Cazadero, Sonoma Co.,

This variety, especially as represented in the first two specimens cited, is so strikingly different from the normal form that we were at one time on the point of treating it as a species, which we were finally deterred from doing by discovering that two or three of our Californian specimens, *e. g.*, those cited under *C. divaricata* from Mt. Diablo and (in part) from Lake Lagunitas, seem to hold a clearly median ground, the leaf peculiarities of the two forms being in one observed case even exhibited in different parts of a single plant. We have sometimes seen a very distinctly roughened or subpapillate cuticle in European specimens of *C. divaricata*, *e. g.*, Carr. & Pears. Hep. Brit. 261, but spinulose teeth or even short cilia 2 or 3 cells long from the back of the leaf we have been unable to discover elsewhere and we find no record hitherto of any such peculiarity in this species or its allies.

5. CEPHALOZIA TURNERI (Hook.) Lindb. Acta Soc. Sci. Fenn. **10**: 502. 1875.

Jungermannia Turneri Hook. Brit. Jung. *pl. 29*. 1816.

Anthelia Turneri Dumort. Rec. d'Obs. Jung. 18. 1835.

Prionolobus Turneri Schiffn.; Eng. & Prantl, Nat. Pflanzenfam. **I**^{3}: 98. 1895.

Bright green, becoming pallid or rusty-brown, very small, depressed-caespitose or creeping among mosses; stems 2–6 mm. long, terete, 60–100 μ in diameter, usually ascending at the apex, subramose, the branches lateral, very rarely strictly ventral, cortical cells subpellucid, root-hairs rather few: leaves mostly approximate, often crowded and equitant, complicate-bilobed $\frac{1}{2}$–$\frac{2}{3}$ their length, the margin everywhere sharply and unequally serrate-dentate, the lobes ovate or ovate-lanceolate, acute or apiculate, the dorsal suberect and somewhat parallel to the stem, the slightly broader ventral usually patent; leaf-cells quadrate-hexagonal, 14–20 μ, the walls strongly thickened especially near the angles: underleaves wanting: polyoicous: androecium usually median, the perigonial leaves similar to the others but sometimes a little larger and more closely imbricate: archegonia terminal on a commonly much elongated branch: bracts two or three pairs, increasing in size upward, the inmost twice the size of the leaves, often highly connate with each other and with the bracteole, spinulose-dentate, bifid, the lobes acute or subacuminate; bracteole ovate, subacuminate, spinulose-dentate, otherwise usually entire, sometimes connate with only one of the bracts; outer bracts commonly distinct, outer bracteoles wanting or only one present; perianth linear-oblong, 1 mm. × .25–.35 mm., pentagonal-prismatic with pronounced carinae, of a single layer of cells or sometimes bistratose at the extreme base or at the angles, often decolorate toward the rounded apex, the mouth nearly closed, denticulate or very obscurely ciliolate: capsule oblong-oval, .35–.4 mm. × .22 mm.

On stony, lightly shaded banks and on sandy soil, sometimes associated with *Claopodium leuconeuron* and *Catharinea undulata* or with *Nardia crenulata*, rarely on logs or ascending the bases of stumps of *Sequoia sempervirens*.

Marin Co. (Miss M. E. Parsons, May, 1888, in herb. Underwood), Mill Valley (Howe, May 3, 1894, Dec. 31, 1895, Feb. 22, 1896), "Redwood Cañon" on the slopes of Mt. Tamalpais; Duncan's Mills and near Cazadero, Sonoma Co.; Mendocino (584, 618), North Fork of the Little River (687), and Half-Way House (732), Mendocino Co.; near Eureka (974, 1030), Humboldt Co.; near Lake San Andreas, San Mateo Co.; Twin Oaks, San Diego Co. (F. W. Koch, Dec. 28, 1895).

Exsicc. Hep. Am. 174.

The above species, first described from Bantry, Ireland, and since recorded from a few other localities in Ireland, England, France, the Canary Islands, and northern Morocco, seems to be

more common in the coast counties of California than in the Old World. The only European specimen that we have been able to use for comparison is one collected by G. Davies in Ashdown Forest, Sussex, England, in 1881, which we owe to the generosity of Matthew B. Slater, Esq., of Malton; this unfortunately lacks mature perianths, yet the correspondence of the Californian plants with it, so far as it goes, and with the detailed description of the species given by Dr. Spruce is so close that we have no ground for doubting their specific identity. A slight difference possibly lies in the more frequent occurrence in the Californian specimens of concrescence on both sides between bracteole and bracts, forming a complete cup with an erect acutely lobed limb, yet Spruce says of the specimens collected in Ireland by Lindberg, "*bractae intimae cum bracteola biloba in excipulum alte connatae*";* on the other hand, the bracteole in our plants is sometimes free on one margin and the bracts may even be found, though very rarely, to be quite distinct dorsally.

The collection of this species in San Diego County by Mr. Koch suggests that it probably occurs also in the intervening coast region.

27. KANTIA S. F. Gray (as *Kantius*) Nat. Arr. Brit. Pl. 1: 706. 1821.

Calypogeja Raddi *p. p. min.* Atti Soc. Ital. Sci. Mod. **18**:—(31). 1818. Mem. Mat. e Fis. Soc. Ital. Sci. Mod. **18**: 42. 1820.

Cincinnulus Dumort. Comm. Bot. 113. 1822.

Calypogeia Corda; Opiz, Beitr. 653. 1829.†

Plants medium-sized, depressed-caespitose, light green, sometimes darkening on drying. Stems prostrate, or ascending at the often gemmiparous apices, subsimple or with irregularly disposed branches, these, with rare exceptions, arising somewhat laterally from the axils of the underleaves; root-hairs very long, usually numerous, springing in clusters from the base of the underleaves. Leaves alternate, incubous, plane or slightly convex, oblong, ovate, or subrhomboidal, rounded or retuse at the apex, less commonly acute, bidentate, or bilobed, the margins entire; leaf-cells rather large, chlorophyllose or pellucid, rarely with trigones. Under-

* Spruce, On Cephalozia, 72 1882.

† See footnote, page 33.

leaves present throughout, usually $\frac{1}{6}$–$\frac{1}{2}$ the size of the leaves, suborbicular, or sometimes reniform or ovate, the apex bifid, retuse, or entire. Dioicous, autoicous, or paroicous. Sexual branches arising, singly, in pairs, or in groups of three, from the axils of the underleaves, the ♂ branches always originating near the basal margin of the underleaf, the ♀ commonly median. Androecium (in autoicous and dioicous sp.) small, capitate or linear-amentiform, ♂ bracts very small, bifid. ♀ bracts 2 or 3 pairs with similar bracteoles, much smaller than the leaves, suborbicular, ovate, or lanceolate, subentire or 2–4-lobed; archegonia 4–12. Perianth wanting; the ♀ branch developing into a fleshy pendulous subterranean radicelliferous cylindrical or clavate pouch (perigynium), crowned at the mouth with the persistent scale-like bracts and lined internally with clavate-papilliform cells. Calyptra, at maturity, adnate for three fourths or more of its length with the perigynium, and almost equally long, its free portion surrounded by the abortive archegonia. Capsule cylindrical, dehiscing to the base by linear spirally wound valves, these bistratose, the walls of the outer layer of cells nearly or quite destitute of local thickenings, those of the inner layer with numerous semiannular bands; seta long; involucellum highly developed, finally adnate to the calyptra and reaching nearly to the line of departure of calyptra and perigynium-wall, its cells elongated and sinuous. Elaters bispiral.

1. KANTIA TRICHOMANIS (L.) S. F. Gray, *l. c.*

Mnium trichomanis L. Sp. Pl. 1114. 1753.

Jungermannia Trichomanis Dicks. Pl. Crypt. **3**: 10. 1793. Hook. Brit. Jung. *pl. 79.* 1816.

Jungermannia Sprengelii Mart. Fl. Crypt. Erlang. 133. *pl. 3. f. 6.* 1817.

Cincinnulus Trichomanis Dumort. *l. c.*

Calypogeia Trichomanis Corda, *l. c.* Nees, Naturgesch. Eur. Leberm. **3**: 8. 1838.

Densely depressed-caespitose or straggling among mosses: stems 8–25 mm. long, .1–.36 mm. in diameter, simple or sparingly branched, prostrate and terminating obtusely, or often attenuate, ascending, and microphylline at the apex and crowned with a subglobose cluster of gemmae: leaves usually closely imbricate, ovate, .9–.18 mm. × .63–1.4 mm., slightly decurrent ventrally, becoming, in the more slender conditions, smaller, merely approximate or even somewhat distant, subrhombic, dimidiate-ovate, and strongly decurrent, apex in all commonly rounded, occasionally

retuse, sometimes acute, rarely bidentate; superior and median leaf-cells 35–65 μ, the chloroplasts mostly close to the vertical walls, trigones wanting or indistinct; gemmae ovoid, of one or two cells: underleaves orbicular to broadly ovate, 1–3 times as broad as the stem, distant, approximate, or imbricate, bifid to below the middle or merely retuse, the lobes acute or obtuse, entire or rarely with a tooth on the outer margin: autoicous (polyoicous?): androecium short and capitate or becoming linear-amentiform and attaining a length of 1 mm. or more, arising from the same axil with the ♀ branch or at a distance from it; antheridia solitary, ovoid, about .1 mm. in greatest diameter, short-stalked: archegonia 4–7: perigynium cylindrical, 1.5–2.5 mm. × .6–.9 mm.: capsule 1.5–2.5 mm. × .55 mm.; seta 1–2.5 cm. long; spores 12–16 μ, very minutely punctulate; elaters 180–350 μ × 11–15 μ, rather obtuse.

On moist banks and decaying logs. Common in the Coast Range Mountains. Mill Valley, Redwood Cañon, and Olema, Marin Co.; Duncan's Mills (*c. fr.*) and Cazadero (*c. fr.*), Sonoma Co.; North Fork of the Little River (640, 660, 696) and Mendocino (583), Mendocino Co.; Eureka (903, 1221), Humboldt Co. Collected also by Dr. Bolander at Mendocino and in "Devil's Cañon, Forest Hill, Sierra Nevada, no. 4620."

The Californian specimens belong chiefly to what is sometimes treated as a variety or species under the name *Sprengelii*, departing from the form ordinarily considered typical in the smaller more ovate underleaves, which are deeply bifid, with the lobes acute. The underleaves, however, often show such extremes of form and size in a single tuft and such gradual transitions between these extremes that we are convinced that any attempt to divide this group into two species according to the character of the underleaves is both unnatural and inconvenient. While the Californian specimens represent, in our opinion, but a single species, the determination of what name this species shall bear is attended with some little difficulty owing principally to the various ways in which *Kantia trichomanis* has been interpreted and defined by European authors. Lindberg* has made the relation of the antheridia to the archegonia a ground for distinguishing *Kantia calypogeia* (Raddi) Lindb. from *Kantia trichomanis*, describing the former as autoicous and the latter as paroicous, and Kaalaas† has

* Hep. Utveck. 32. 1877. Kongl. Sv. Vet.-Akad. Handl. 23½: 25. 1889.

† Nyt Mag. for Naturvidensk. 33: 201. 1893.

correlated with these characters others drawn chiefly from the underleaves and leaf-apices. Nees von Esenbeck,* however, gives the impression that his *Calypogeia trichomanis* is dioicous and the species is so described by Limpricht † and by Stephani.‡ Gottsche § on the other hand, twice states that the ♂ and ♀ branches may arise side by side from the axil of a single underleaf. Spruce remarks: ¶ "Our *Kantia Trichomanis* (*Calypogia Tr.*, Syn. Hep.) is also certainly monoicous, and fruits freely in the Castle-Howard woods in the springtime. The flowers stand normally three together, in the axil of a foliole, thus (♂ ♀ ♂); but one or other flower in each triplet is apt to be obsolete, thus obscuring the monoicous character. We have probably a second species, in bogs and wet places, with dioicous inflorescence, and large, very slightly notched (or even quite entire) folioles; but I have seen no fertile specimen." In a reprint of this paper ("On Anomoclada") in possession of Professor Underwood, Dr. Spruce has written "*K. Trichomanis*" on the margin opposite the words "probably a second species" and "*K. Sprengelii*" (Mart.)" opposite the reference to the monoicous species. In none of the Californian specimens (and in none from the eastern United States, so far as investigations have been made) have we been able to demonstrate paroicous inflorescence. By persistent searching we have always been able to find antheridia, when they are to be found at all, occupying purely ♂ branches on plants which bear also ♀ branches There is, however, an apparent tendency to become dioicous, which is especially pronounced in plants with large, merely emarginate underleaves. In European specimens, also, we are satisfied that the correlation, as defined by Kaalaas, between the position of the antheridia and the characters of the underleaves, leaf-apices, etc., does not always exist. For example, an autoicous or perhaps polyoicous specimen collected in Germany by Herr F. Stephani has leaves and underleaves which are very decidedly of the type

* Naturgesch. Eur. Leberm. 3: 19. 1838.

† Cohn, Krypt.-Fl. Schles. 1: 310. 1877.

‡ Berichte Bot. Ver. Landshut, 7: 143 (51). 1879.

§ Acta Acad. Caes. Leop.-Carol. Nat. Cur. 21²: 427. 1845. Abhandl. Naturw. Ver. Hamb. 7: 41. 1880.

¶ Jour. Bot. 14: 164. 1876.

conceived by Kaalaas to be peculiar to *Kantia trichomanis*. It should, perhaps, be remarked that in European, as in American, specimens of *Kantia trichomanis*, we have as yet been unable to discover antheridia in the axils of the ♀ bracts—doubtless due to the fact that most of the European specimens of *Kantia trichomanis* accessible to us are in an unfavorable condition for the demonstration of antheridia. To what extent paroicous inflorescence prevails in the European plants and in how far and how constantly it may be associated with other characters are matters which we hope will soon be exhaustively investigated by European hepaticologists. Inasmuch as Linnaeus' specimen of *Mnium trichomanis*, if he ever had one, is not preserved, it would appear that the only way of interpreting the diagnosis, "*Mnium foliis distichis integerrimis*" is by calling to our assistance the only synonym that he quotes, viz.: "*Mnium trichomanis facie, foliolis integris.* Dill. musc. 236. *t. 31. f. 5.*" This Dillenian plant Lindberg has declared * to be "*Kantia calypogea* (Dood.; Radd.) Lindb. sacciſera.—Haec species est autoica, *K. trichomanis* (L.) Lindb. tamen paroica." On this showing it seems a little strange that Lindberg should not have pinned the name "*trichomanis* (L.)" down to the autoicous form and given his paroicous species a new name. It is, however, to be noted that this determination is out of harmony in one or two particulars with his earlier determinations of the plants preserved in the Dillenian herbarium, for he once wrote :† "Secundum specimina, in herbario ejus nunc asservata, *Mnium* Dillen. Hist. musc. tab. 31, figg. et 5 et 6 ad *K. trichomanis α 2 fissam* [afterwards *K. calypogeia* (Raddi) Lindb.] pertinent! Sed (fig. 5) caespes componitur et ab hac forma (dioica), ♂ et sacculos juveniles gerente, et ab intermixta *K. arguta*, ster. et gonidiifera!" One will observe that the sacciferous plant is here declared to be dioicous! Whether the determination of three years later was a rectification based upon a reëxamination of the Dillenian specimen we are not informed. But whether autoicous or dioicous, it certainly appears quite unjustifiable to limit the name "*trichomanis*" to an exclusively *paroicous* form.

* Hep. Utveck. 32. 1877.

† Not. Sällsk. pro Fauna et Flora Fenn. Förhandl. 13: 364. 1874.

28. LEPIDOZIA * Dumort. Rec. d'Obs. Jung. 19. 1835. G. L. & N. Syn. Hep. 200. 1845.

Pleuroschisma § *Lepidozia* Dumort. Syll. Jung. 69. 1831.

Mastigophora Nees, Naturgesch. Eur. Leberm. 1: 95, 101. 1833.

Herpetium § *Lepidozia* Nees, *op. cit.* 3: 31. 1838.

Plants small or moderately large, pallescent or yellowish-green, in dense, often depressed mats. Stems prostrate or ascending, rarely erect or pendulous, pinnately or bipinnately branched, often beautifully plumose, the vegetative branches lateral in origin, rarely ventral; root-hairs rather scanty, mostly from the ventral surface of the underleaves. Leaves incubous, small, ventrally concave, decurved, unsymmetrical, usually as broad as long, palmately 4- (rarely 2- or 3-, or 5- or 6-) cleft or -parted, the segments lanceolate or subulate and (in our species) entire; leaf-cells rather small or medium-sized. Underleaves present throughout, similar to the leaves but symmetrical and somewhat smaller. Dioicous or autoicous. Androecium occupying a short ventral ramulus or rarely terminal on a lateral branch; ♂ bracts suborbicular, saccate-concave, larger-celled, mostly bilobed, bracteoles much smaller; antheridia single. Archegonia few or numerous, terminal on a short ventral, often strongly radicelliferous, branch. ♀ bracts 3–5 pairs, the inmost mostly three times larger than the cauline leaves, all larger-celled and more translucent, 2–4-lobed or -dentate at apex, the margins entire, denticulate, or spinose: bracteoles similar. Perianth free, cylindrical-ovoid to narrowly fusiform, more or less distinctly trigonous above, with the third angle ventral, gradually contracted at the apex toward the rather small denticulate or ciliate-laciniate mouth. Calyptra ½–¼ as long as the perianth. Capsule cylindrical-ovoid, dehiscing to the base by straight valves, these 2–4-stratose, the walls of the external cells with columnar or nodular thickenings, those of the inmost layer with semiannular bands; seta moderately long. Elaters bispiral.

* In order to retain in use *Lepidozia* as a generic name, we recognize its subgeneric priority. The *Mastigophora* Nees of 1833 was rather briefly defined and no species were cited under it, yet in 1838 Nees mentions *Mastigophora reptans* as a synonym of *Herpetium reptans* and refers to page 101 of the first volume of the Eur. Leberm. as the place of publication, where, however, no specific names are to be found. There can, therefore, be no possible doubt as to what Nees intended to have understood under his *Mastigophora* of 1833. But in 1838 Nees reverted to Dumortier's sectional name *Lepidozia* (using it for a section of *Herpetium*, and without any allusion to Dumortier's work of 1835, in which *Lepidozia* was raised to generic rank) and forthwith transferred the name *Mastigophora*, with full diagnosis, to a very different plant (*Jungermannia Woodsii* Hook.).

1. LEPIDOZIA REPTANS (L.) Dumort. Rec. d'Obs. Jung. 19. 1835.

Jungermannia reptans L. Sp. Pl. 1133. 1753.

Pleuroschisma reptans Dumort. Syll. Jung. 69. 1831.

Herpetium reptans Nees, Naturgesch. Eur. Leberm. 3: 31. 1838.

In depressed mats or creeping among mosses: stems prostrate, 6–25 mm. long, .18–.36 mm. in diameter, subpinnately to bipinnately ramose, the branches ending obtusely or often becoming flagelliform: leaves obliquely inserted, patent-horizontal to erecto-patent, mostly approximate or subimbricate, rarely distant, subquadrate, inclining occasionally to ovate or obovate, .36–.45 mm. long, .25–.54 mm. broad, decurved, 3- or 4- (rarely 2-) cleft for ⅓–½ their length, the lobes unequal, mostly lanceolate-acute or subulate, incurved, 4–8 cells wide at base; leaf-cells 24–48 μ, their firm walls obscurely or not at all incrassate at the angles, cuticle smooth: underleaves distant or contiguous, subquadrate, broader than long, ⅖–⅔ the size of the leaves, mostly 4-lobed to about the middle, the lobes usually obtuse: autoicous: androecium typically on a short ventral branch, rarely borne on a branch of lateral origin: axis of ♀ branch about .5 mm. long, archegonia 2–6: ♀ bracts 2–3-dentate at apex, margins entire or slightly denticulate: perianth subcylindrical or narrowly ovoid-conical, 2–2.7 mm. long, .63–1 mm. in greatest width (below the middle), rounded-trigonous above, the wall of 2 or 3 layers of cells in the basal half or third, otherwise unistratose, the mouth denticulate: capsule about 1.2 mm. × .7 mm.; seta 1–2 cm. long; spores 14–16 μ, distinctly granulate-papillate; elaters 200–325 μ × 10–16 μ, rather obtuse.

On old logs in moist woods, on banks of streams, among mosses, etc. Not especially common in California. "Redwood Cañon," near Mill Valley, Marin Co.; near Mendocino (720) and North Fork of the Little River (658), Mendocino Co.; Eureka (906, 929), Humboldt Co.; near Hay Fork (1120), Trinity Co.; Sisson (36), Siskiyou Co. Collected at Mendocino also by Dr. Bolander and in Marin County by Professor Underwood (June, 1888).

Dr. Spruce,* in describing the dioicous *Lepidozia Pearsoni*, in which the androecia normally terminate lateral branches, has stated that in *Lepidozia reptans* the male spike always occupies a postical branch. The Californian specimens of *Lepidozia reptans*, however

* Jour. Bot. 19: 35. 1881.

—though apparently always autoicous—occasionally show an antheridial spike at the end of a lateral branch, and we have observed the same conditions in certainly autoicous plants of G. & R. Hep. Eur. 282.

Lepidozia filamentosa * (Lehm. & Lindenb.) Lindenb.—a very distinct species, now certainly known only from Alaska—will probably yet be found to extend farther down the coast, though we are inclined to doubt its occurrence within the limits of California. This species is larger in all its parts † than *Lepidozia reptans* and more rigid and brittle in drying. The main stems are 2–3 cm. long and .36–.65 mm. in thickness. The leaves are almost transversely inserted and erecto-patent to suberect; the underleaves are proportionally larger than in *L. reptans*, being $\frac{2}{3}$–$\frac{4}{5}$ the size of the lateral leaves; the fronds have therefore the appearance of being almost uniformly developed on all sides instead of being distinctly dorso-ventrally flattened. Fig. 4 in Lindenb. & Gottsche's plates scarcely does justice to the similarity in size of the leaves and underleaves; and Taylor's "stipulis minutis" of "*Lepidozia attenuata*" is difficult to understand in view of the undoubtedly authentic original specimen existing in his herbarium, which is an exact counterpart of the original of *Jungermannia filamentosa*, now preserved in the Natural History Museum of Vienna. In the original of *L. filamentosa* the perianths are 4–6 mm. long and are widest at the middle or a little above; the only capsule seen is 2 mm. long. Menzies was probably the first collector, though his name is not cited by Lindenberg and does not appear on the Vienna specimen. The species has since been collected, so far as we know, but twice: by J. M. Macoun, Prince of Wales Sound, Alaska, September, 29, 1891 (no. 389, associated with *Scapania Bolanderi*, in herb. Underwood), and by Miss Jessie Trowbridge, Sumdum, Alaska, 1895 (in herb. Howe). The species is apparently dioicous. We have seen perianths only upon the original specimen. The androecia are upon ventral branches. The main stems and lateral branches (especially

* LEPIDOZIA FILAMENTOSA Lindenb. (excluding var. β?); G. L. & N. Syn. Hep. 206. 1845. Lindenb. & Gottsche, Sp. Hep. fasc. 6 & 7: 36. *pl. 6.* 1846.
Jungermannia filamentosa Lehm. & Lindenb.; Lehm. Pugill. 6: 29. 1834.
Lepidozia attenuata Tayl. Lond. Jour. Bot. 5: 369. 1846.

† With the exception of the leaf-cells, which are a trifle smaller and more opaque

in ♀ plants?) sometimes terminate in a somewhat enlarged, rather dense, rosette of leaves.

Lepidozia humillima Tayl. (*l. c.*) "Northwest coast of America? Menzies" is a *Cephalozia.*

29. BLEPHAROSTOMA Dumort. *p. p.* Rec. d'Obs. Jung. 18. 1835. Spruce, On Cephalozia, 86. 1882.

Jungermannia § *Blepharostoma* Dumort. *p. p.* Syll. Jung. 65. 1831.

Chaetopsis Mitt. Jour. Linn. Soc. **8**: 53. 1865.

Blepharostoma § *Chaetopsis* Schiffn.; Eng. & Prantl, Nat. Pflanzenfam. I^3: 104, 105. 1895.

Plants small, sometimes very slender and delicate. Stems usually prostrate-entangled, the branching normally lateral or subdichotomous. Leaves transversely inserted, divided very nearly or quite to the base into 2–5 rigid and setaceous or soft and capillary, simple or less commonly furcate laciniae, each consisting of a single row of cells throughout. Underleaves very similar, their laciniae sometimes fewer by one and occasionally a little shorter. Archegonia few, terminal on the main stem or on the principal branches. ♂ bracts usually more crowded than the leaves, their laciniae sometimes more numerous and often forked; antheridia ovoid, solitary or very rarely binate. ♀ bracts gradually larger than the leaves, free from the perianth, distinct or the inmost slightly connate at the base, the often much branched laciniae springing from a basilar membrane several cells in height; bracteoles similar. Perianth subpyriform to elongate-cylindrical, its wall composed of a single layer of cells, the mouth ciliate. Capsule dehiscing to the base by four straight valves. Seta rather short or moderately long. Elaters bispiral, obtuse.

Key to the Species.

Leaves mostly with 3 or 4 laciniae, their cells 40–70 $\mu \times$ 16–32 μ, 1½–2½ times as long as broad, thick-walled, the septa usually strongly thickened toward the periphery and slightly protuberant. 1. *B. trichophyllum.*

Leaves mostly with 2 or 3 laciniae, their cells 50–112 $\mu \times$ 25–50 μ, 1½–4 times as long as broad, thin-walled, slightly contracted at the septa (which are never at all protuberant). 2. *B. arachnoideum.*

1. BLEPHAROSTOMA TRICHOPHYLLUM (L.) Dumort. Rec. d'Obs. Jung. 18. 1835.

Jungermannia trichophylla L. Sp. Pl. 1135. 1753.

Chaetopsis trichophylla Mitt. Jour. Linn. Soc. **8**: 53. 1865.

Green or yellowish-green, intricately caespitose or straggling among other bryophytes: stems rather rigid, 4–20 mm. long, .06–.27 mm. in diameter, with often copious lateral or dichotomous branching, cortical cells subopaque, 7–14-seriate, 28–96 μ × 15–32 μ, axile cells 4–12-seriate; root-hairs infrequent: leaves close or somewhat widely spaced, erecto-patent or suberect, divided nearly to the base into 3 or 4 rigid setaceous laciniae (occasionally five or in very slender conditions rarely reduced to two), these .4–.65 mm. (8–13 cells) long, usually connate for ½–¾ the height of the basal cells, or sometimes with a basilar membrane one cell in height; leaf-cells 40–70 μ × 16–32 μ, 1½–2½ times as long as broad, thick-walled, the septa usually strongly thickened toward the periphery and slightly protuberant, giving the laciniae a somewhat nodulose outline; cuticle granulate or striatulate: underleaves similar to the lateral leaves, their laciniae commonly one or two cells shorter: paroicous, or with antheridia on the same axis but a little removed from the ♀ bracts, or sometimes dioicous: ♂ bracts with a narrow basal membrane, the laciniae usually once furcate; antheridia about .15 mm. in diameter, the short stalk composed of a single row of cells: archegonia 4–7: ♀ bracts 4–6-laciniate with a basilar membrane 2–6 cells high, the laciniae furcate or often with an antler-like ramification: perianth highly exserted, cylindrical or pyriform-cylindrical, 1.5–2.2 mm. × .45–.8 mm., inflated, with usually one or two deep furrows toward the apex, the rather wide mouth somewhat abruptly drawn together and fringed with long, mostly connivent cilia: calyptra thin, free, about half as long as the perianth: capsule ellipsoid-oval, .6–.9 mm. long, the valves bistratose, the cell-walls of the outer layer with purplish-brown columnar thickenings, those of the inner layer with similar thickenings and with imperfect semiannular fibers; seta 5–12 mm. long; foot deeply penetrating the stem-apex, descending to the plane of insertion of the third set of bracts; spores 14–18 μ, minutely granulate-papillate; elaters 130–300 μ × 9–11 μ.

On logs and moist soil.

Fish Creek, Mariposa Co. (Miss Edith S. Byxbee, July, 1895); near Mendocino (668, 722); Blue Lake, Humboldt Co. (1009).

2. **Blepharostoma arachnoideum** sp. nov.

Pallid or yellowish-green, depressed-caespitose, very delicate, confervoid, mostly pulverulent-nitent owing to the presence of gemmae: stems flaccid, 2–5 mm. long, .05–.22 mm. in diameter, simple or sparingly branched, the branching dichotomous, lateral, or sometimes strictly ventral, cortical cells 4–10-(mostly 6- or 7-) seriate, pellucid, 48–160 μ × 25–60 μ, the dorsal a little larger

than the ventral, axile cells 1–6-seriate; root-hairs very long, colorless or yellowish, usually wanting, springing, when present, singly or in groups of 2 or 3 from near the places of insertion of the underleaves: leaves rather widely spaced, patent or erecto-patent, divided nearly or quite to the base into 2 or 3 capillary laciniae (very rarely four, or in attenuate conditions sometimes reduced to one), the laciniae .36–.75 mm. (6–11 cells) long, often once forked at about the middle or above, discrete to the very base or more commonly connate for ¼–½ the height of the basal cells, slightly contracted at the septa; leaf-cells mostly 50–112 μ × 25–50 μ, 1½–4 times as long as broad, hyaline, thin-walled, the septa sometimes slightly thickened toward the periphery but never at all protuberant; cuticle (of the cortical cells as well) minutely striatulate: underleaves very similar in all respects to the lateral leaves: gemmae frequent, especially toward the stem-apex, unicellular, oblate-ellipsoidal, 25 μ in greatest diameter, formed by the multiplication in a single series and reduction in length of the terminal cells of the leaf-segments, the resulting submoniliform chains composed often of 12–18 cells: remaining parts unknown.

On old logs in moist woods, "Russian Gulch," near Mendocino (703—the type) and North Fork of the Little River (1222), Mendocino County.

The above species is strikingly distinct from *Blepharostoma trichophyllum*. *Blepharostoma sejunctum** Ångst., from Brazil, is doubtless a nearer ally, judging from description alone, but the Californian plant evidently differs from this in the shorter and rather stouter stems, in having often 3 leaf-laciniae, the basal cells of which are commonly more or less connate, in the broader leaf-cells, and probably also in the ramification. In habit and delicacy of structure, *Blepharostoma arachnoideum* is suggestive of Dr. Spruce's genera *Telaranea* and *Arachniopsis*. The occasional occurence of a postical branch is an aberrant character in *Blepharostoma*, with which genus, however, the equally developed three ranks of leaves plainly unite our plant. The species, in a sense, connects *Blepharostoma* with *Telaranea*, which, in turn, as Spruce remarks, is with difficulty kept separate from *Lepidozia*.

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*Öfvers. Kongl. Vetensk.-Akad. Förhandl. 1876[7]: 78. 1876. The width of the laciniae is here given as "0,003 millim." which is evidently a misprint for 0,03 millim.

30. ANTHELIA Dumort. *p. p.* Rec. d'Obs. Jung. 18. 1835. Schiffn.; Eng. & Prantl, Nat. Pflanzenfam. I^3: 106. 1895.

Jungermannia § *Anthelia* Dumort. *p. p.* Syll. Jung. 63. 1831. *Anthelia* § *A.* Spruce, On Cephalozia, 80. 1882.

Plants small, densely caespitose, olivaceous-green or glaucescent.* Stems stout for the size of the plant, opaque, irregularly pinnate, the branches all lateral, cortical cells multiseriate, small to medium-sized; root-hairs few or abundant. Leaves small, transversely inserted, erect or erecto-patent, somewhat complicate-carinate, commonly equitant-imbricate, bifid to the middle or below, the lobes subacuminate, several cells in width except at the extreme apex, the margins entire or erose-denticulate. Underleaves similar to the lateral and scarcely smaller, the stems, therefore, appearing uniformly tristichous-foliate. Dioicous or paroicous. Antheridia large, solitary in the axils of but slightly modified leaves. Archegonia few, terminal on the main stem or the leading branches. ♀ bracts gradually larger than the leaves, densely crowded, more often denticulate, more or less fused with the base of the perianth and the hollowed-out stem-apex, distinct or rarely somewhat connate at base, the apices commonly hyaline. Perianth ovoid to short-cylindrical, deeply unisulcate dorsally and 2- or 3-carinate ventrally, 8–10-plicate at the slightly narrowed lobate-dentate mouth, the wall of 2 or 3 layers of cells near the base, otherwise unistratose. Calyptra 2 or 3 cells thick, carrying on its surface the sterile archegonia and sometimes also small scale-like paraphyses. Capsule subglobose, dehiscing to the base by straight valves, which are composed of two layers of cells, the walls of the outer layer with columnar or nodular thickenings, those of the inner layer similarly marked toward the base of the capsule but bearing toward the apex more or less perfect semiannular fibers; seta short. Elaters 2- or 3-spiral.

1. ANTHELIA JURATZKANA (Limpr.) Trevis. Mem. r. Ist. Lomb. III. 4: 416. 1877. Spruce, On Cephalozia, 82. 1882.

Jungermannia Juratzkana Limpr.; Cohn, Krypt.-Fl. Schles. 1: 289. 1877. Hedwigia, 15: 18. 1876.

* Herbarium specimens of *Anthelia* are often thickly covered with a delicate white cobwebby growth, which under a magnification of 500 diameters is found to consist of very slender short and rigid or long and flexuous threads about 1 μ in diameter and of homogeneous structure. The organism is evidently one of the colorless schizophytes, but further than this we would not attempt to express an opinion as to its systematic position. Schizophyceae and mycelia of fungi are usually also present in greater or less abundance.

(?) *Jungermannia nivalis* Sw.; Wahlenb. Fl. Carp.* 363. 1814. Wahlenb. Fl. Suec. 779. 1826.

Anthelia nivalis Lindb. Musc. Scand. 5. 1879. Kaalaas, Nyt Mag. for Naturvidensk. 33: 232. 1893.

Plants dark green or glaucescent at the apices, brownish below, forming wide dense mats 2–4 mm. in thickness: primary stems prostrate or decumbent, the principal branches erect, .08–.26 mm. in diameter, sparingly radicelliferous; leaves erect-appressed, usually crowded, more distant on slender sterile stems, ovate, .3–.35 mm. long, bifid ½–¾ their length, the lobes ovate-lanceolate, subacuminate, the margins entire or very slightly erose-denticulate; leaf-cells rectangular-oblong to subquadrate, 16–40 μ in greatest diameter, rather thin-walled: paroicous: bracts several pairs, a little saccate at base, apices denticulate, bracteoles similar: perianth scarcely exserted, ovoid, 1–1.6 mm. × .6–.7 mm., lobulate at the somewhat contracted mouth: capsule .5–.7 mm. in diameter, on a seta 1–3 mm. long; spores 16–24 μ in maximum diameter, granulate-papillate; elaters 120–175 μ long, 11–14 μ in greatest diameter, somewhat attenuate at the extremities, mostly trispiral.

On rocks in alpine regions. "California, Bolander" in herb. U. S. National Museum (under the name *Anthelia julacea*). It seems probable that Dr. Bolander's specimen was collected on Mt. Dana in September, 1866.

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* This citation is as given by authors. We have been unable to consult this earlier work of Wahlenberg's and have also failed to see the "W. M. Ind. musc." in which *Jungermannia nivalis* as a *nomen nudum* is said to have made its first appearance. Though we have not been able to see all the literature bearing upon the point, we are of the opinion that *Jungermannia nivalis* Sw. should be treated as an exact synonym of *Jungermannia julacea* Lightf., inasmuch as we are in possession of no evidence (as has already been said, in effect, by Dr. Spruce) that Lightfoot, Swartz, or Wahlenberg distinguished between what we now recognize as *Anthelia julacea* and *Anthelia Juratzkana*. *Jungermannia nivalis* could then be cited as a synonym for *Jungermannia julacea*, in the restricted sense of Limpricht, with as much justice as for *Jungermannia Juratzkana*. At all events, in Wahlenberg's Flora Suecica, *Jungermannia nivalis* is used in contradistinction to *Jungermannia julacea* which is applied to the *Jungermannia concinnata* of Lightfoot and of Hooker, and the diagnosis of *Jungermannia nivalis* as there given, would, on the whole, ("*surculis setaceis ramosis*;" "*surculi* * * * *flexuosi*") be more suggestive of the dioicous species. Lindberg, it is true-states (Kongl. Sv. Vet. Akad. Handl. 23⁵: 29. 1889) that his *Anthelia nivalis* (the paroicous species) is very common in Scandinavia while *A. julacea* is very rare, but Kaalaas (Nyt Mag. for Naturvidensk. 33: 230, 231, 233, 234. 1893) finds the two species about equally abundant in Norway. Until proof is forthcoming that *Jungermannia nivalis* was originally applied to the paroicous species we prefer, with Spruce, to use a specific name concerning whose original meaning there is no doubt.

Anthelia julacea (L.; Limpr.) Dumort.—a nearly related species, which may be expected to occur in California—is distinguished by its larger size, dioicous inflorescence, thicker-walled leaf-cells, and bispiral elaters.

31. PTILIDIUM Nees, Naturgesch. Eur. Leberm. **1**: 95. 1833.
Blepharozia Dumort. Rec. d'Obs. Jung. 16. 1835.

Usually in dense and commonly brownish mats. Stem prostrate or ascending, 1–2-pinnate or irregularly and sparingly branched, eflagelliferous, the branches lateral; root-hairs few and short. Leaves obliquely inserted, twice bifid to below the middle or palmately 3–5-cleft, the dorsal segments larger and incubous, all filiform-acuminate, the segment-margins entire, or more commonly fringed with long, simple or branched cilia. Underleaves much smaller but otherwise somewhat similar, more or less distinctly 2- or 3-parted. Antheridia short-stalked, on the main stem or lateral branches, in the axils of more concave and more closely imbricate but otherwise scarcely modified leaves. Archegonia terminal on what is primarily the main stem or a principal branch, the perianth, however, through innovation below, finally apical on a short apparently lateral or dichotomously divergent branch. Bracts commonly one or two pairs, similar to the leaves or often more profusely ciliate-laciniate. Perianth free, several times longer than the bracts, cylindrical-obovate, ciliate and subplicate at the somewhat contracted mouth. Calyptra free. Capsule ovoid on a moderately long seta, dehiscing to the base by four rather rigid valves, the cells of the latter bearing semiannular and also brownish nodular thickenings. Spores punctulate, several times broader than the 2- (3-) spiral elaters.

1. PTILIDIUM CALIFORNICUM (Aust.) Underw. & Cook, Hep. Am. 69. May, 1890. Pearson, List Can. Hep. 7. 16 Je. 1890.
Lepidozia? Californica Aust. Bull. Torr. Bot. Club, **6**: 19. 1875.
Mastigophora Californica Aust. Bull. Torr. Bot. Club, **6**: 302. 1879.

Brownish or greenish-yellow, usually in dense appressed mats: stems subfiliform and flaccid or becoming somewhat stout, mostly 2–3 cm. long, irregularly and sparingly branched, rarely subpinnate or subbipinnate: leaves loosely imbricate, palmately 3- or 4-cleft to below the middle, the segments lanceolate or more commonly linear-lanceolate, filiform-attenuate, unequal, the ventral

smaller and subinflexed, the segment-margins very entire, repand, or here and there again incised or sometimes bearing a few (2 or 3 on a side) long and rather rigid cilia: underleaves usually a little broader than the stem, deeply 2- or 3-parted, the segments inciso-ciliate; leaf-cells 40–45 μ, hexagonal- or pentagonal-rotund, the walls strongly thickened at the angles, cuticle smooth: dioicous: ♂ plants commonly more slender, androecium cauline or rameal, antheridia ovoid or ellipsoidal, single or in pairs, the stalks finally much shorter than their long diameter: ♀ branch short, bearing about 2–4 pairs of leaves inclusive of bracts: bracts one or two pairs, a little larger than the leaves and more inciso-ciliate; bracteole similar, rarely connate with bracts on one or both sides; perianth cylindrical-obovoid to subfusiform-oblong from an obconic base, slightly narrowed at the ciliate subplicate mouth: spores brown, 21–30 μ; elaters 120–225 $\mu \times 7$–10 μ, 2- (rarely 3-) spiral, contorted, subobtuse.

Found in California only by its first collector, Dr. Bolander. The plants from which the original description was drawn were picked out from specimens of *Hypnum circinale* in Sulliv. & Lesq. Musc. Bor.-Am. Exsicc., No. 474, ed. 2; these are now preserved in herb. Pearson. Duplicates of this original material may often be found in connection with no. 474 of the Exsicc. cited. Habitat and locality were given as "ad corticem arborum in sylvis Californiae montanae." The specimens doubtless came from Humboldt or Mendocino counties, and the plant is to be looked for on the bark of living trees and fallen trunks of *Sequoia sempervirens* and of other conifers in the northern coast region. The species extends northward to British Columbia (Macoun) and to Idaho (Leiberg). Some of the northern specimens make a nearer approach to *Ptilidium ciliare*, which also occurs in the same region, but are always very distinct in the less branched stem, the more rigid leaves, with much more pronouncedly filiform-attenuate segments and longer, more rigid, and always much less numerous cilia.

PLATE 105. PTILIDIUM CALIFORNICUM.

1. Plants, natural size.
2. Portion of stem, with branch, × 12.
3. Cauline leaf, viewed from above, × 23.
4. Cauline leaf, viewed from below, × 23.
5. A 3-cleft cauline leaf, viewed from below, × 23.
6. A typical apex of leaf-segment, × 41.
7. Cauline leaf, ventral view, × 23.

8. Rameal leaf, ventral view, ×23.
9 and 10. Underleaves, ×23.
11. Androecium, × 12.
12. ♂ bract, × 23.
13. Antheridia, × 23.
14. Bracteole, × 23.
15. Second (next to the inmost) bracteole from another plant, × 23.
16. Inmost bract, × 23.
17 and 18. Ventral and dorsal aspects of perianth and bracts, × 12.
19. Portion of perianth-mouth, × 41.
20. Leaf-cells, × 225.

Figs. 1–6, 9, 10, and 20, drawn from the type specimen collected in California by Bolander, ex. herb. Pearson; the remaining figures from Hep. Am. 69 (Idaho, J. B. Leiberg).

32. SCAPANIA Dumort. Rec. d'Obs. Jung. 14. 1835.

Martinellius S. F. Gray, *p. p. max.* Nat. Arr. Brit. Pl. 1: 690. 1821. Lindb. (as *Martinellia*) Act. Soc. Sci. Fenn. 10: 518. 1875. O. Kuntze (as *Martinellia*), Rev. Gen. Pl. 837. 1891.

Radula Dumort. *p. p.* Comm. Bot. 112. 1822.

Radula § *Scapania* Dumort. Syll. Jung. 38. 1831.

Plants usually large, caespitose, green, brown, rose-red, or dark-purple; primary stems defoliate, creeping, the secondary mostly ascending, sometimes erect, rarely prostrate, simple or dichotomously branched, apex commonly decurved. Leaves alternate, distichous,* complicate-bilobed, the fold rounded outwardly or more often with an acute or somewhat winged keel, margins of the lobes ciliate, dentate, or entire; ventral lobes mostly larger, convex dorsally, succubous; dorsal lobes incumbent; underleaves wanting. Stem-apex and upper leaves sometimes gemmiferous. Dioicous or rarely monoicous; androecium terminal or interrupted; ♂ bracts ventricose, usually smaller and with subequal lobes; antheridia (mostly 1–6) ovoid or ellipsoidal, on pedicels of about their own length, often accompanied by hair-like or leaf-like paraphyses. Archegonia few, at the apices of the main branches. ♀ bracts hardly different from the ordinary leaves, though a little larger and more equally lobed. Perianth oblong or obovate, strongly compressed dorso-ventrally (parallel with the plane of the stem), smooth, or rarely subplicate, the mouth broad, truncate, entire, dentate, or ciliate, decurved when young. Capsule oblong-ovoid, long-exserted, valves thick-walled, the inner layer of cells with semiannular or nodose thickenings. Elaters bispiral, deciduous.

* See *Scapania heterophylla.*

Key to the Species.

Uppermost leaves (in ♀ plants) with long curved teeth on the carina; perianth-mouth denticulate or subentire. 3. *S. Oakesii.*

Leaves without teeth (or very rarely a single tooth) on the carina or fold.

Basal margin of dorsal leaf-lobes with long, decurved, often compound cilia; leaves coarsely dentate; ventral lobes oblong-ovate. 1. *S. Bolanderi.*

Basal margin of dorsal leaf-lobes entire or with small teeth.

Plant ("frond") distinctly complanate; leaves always distichous.

Stems 4–15 mm. long; ventral leaf-lobe very slightly or not at all decurrent.

Leaves bilobed ½–⅔ their length; ventral lobes oblong-ovate, acute or subacuminate, serrate-dentate, deflexed and often somewha. secund; dorsal lobes nearly parallel to the stem, appressed-imbricate above; perianth-mouth entire or repand. 5. *S. umbrosa.*

Leaves bilobed ½ their length; ventral lobes orbicular-ovate to obovate, often obtuse, entire or sparingly dentate; dorsal lobes erecto-patent or patent-horizontal, ascending, never appressed-imbricate; perianth mouth in most cases shortly ciliate-dentate. 6. *S. curta.*

Stems 1–10 cm. long, ventral leaf-lobe decurrent, obtuse, rarely subacute.

Plants aquatic; leaves flaccid, lobes often subequal at apex, sometimes entire, the ventral round-trapezoidal; perianth-mouth repand or subdentate. 4. *S. undulata.*

Plants non-aquatic; leaves somewhat stiff, ciliate-dentate; ventrat lobes obovate, 2–2½ times the size of the dorsal; perianth-mouth ciliate-dentate. 2. *S. nemorosa.*

Plant ("frond") obscurely complanate; leaves sometimes irregularly 3-ranked by interpolation of unlobed leaves, erecto-patent, often with squarrose tips. 7. *S. heterophylla.*

1. SCAPANIA BOLANDERI Aust. Proc. Acad. Nat. Sci. Philad. 1869: 218. 1869.

Scapania caudata Tayl. in herb.

Scapania Californica Gottsche; Cal. Med. Gaz. 1870: 184 (40) (name only). 1870.

Scapania albescens Steph. Bot. Jahrb. 8: 96. 1886.

Olive-green to yellowish-brown, caespitose: stems rigid, ascending, nearly prostrate or subpendulous, 1–4 cm. long, dichotomous, ♀ plant innovating from near base of the perianth: leaves scarcely increasing in size upward, approximate or close, stiff, hardly changed in form or position on drying, acutely complicate, narrowly alate-carinate, the carina entire or rarely furnished with a single tooth; ventral lobes obliquely oblong-ovate, patent, strongly convex, obtuse, slightly decurrent, coarsely dentate, 2½ times greater than the dorsal, apex and ventral margin deflexed; dorsal lobes broadly and obliquely ovate, more or less

imbricate, erect or subappressed, slightly convex, somewhat acute, with fewer and larger teeth and bearing at the base several long decurved often compound cilia; leaf-cells subquadrate-oval, more elongated toward base, 15–40 μ, with conspicuous trigones, cuticle minutely roughened: gemmae at apex of stem, of one or two cells, oval or ellipsoidal, 15–25 $\mu \times 15$ μ: dioicous, ♂ and ♀ plants in the same tuft: androecium terminal or often interrupted; antheridia 2–6, ellipsoidal or obovoid, on stalks of about their own length or longer, accompanied by very numerous, branching, capillary, or leaf-like paraphyses; ♂ bracts scarcely modified or smaller, saccate, densely imbricate, with subequal incisodentate lobes: perianth oblong, more rarely obovate, 2–3.5 mm. × 1.5–1.8 mm., ciliate-lacinulate or doubly ciliate-dentate at mouth: capsule oblong-ovoid, brown, seta 3–10 mm. long; spores 10–12 μ, punctulate; elaters bispiral, obtuse, contorted, 100–175 $\mu \times 8$–10 μ.

Exsicc. Hep. Bor.-Am. 19.

Common in the Coast Range Mountains, north of San Francisco, on logs and stumps of the Coniferae, especially of *Sequoia sempervirens*—more rarely on the bark of living trunks.

Redwood Cañon, Marin Co. (Miss Edith S. Byxbee); Duncan's Mills (1193) and Turner's Cañon (1194), Sonoma Co.; Mendocino (596), Little River (648, 684), and Half-Way House (727), Mendocino Co.; Eureka (911, 928, 938, 984), Humboldt Co. Frequently with sporogonia. Apparently closely confined to the Pacific Coast, ranging as far northward as Alaska. Specimens from Nova Scotia, Ontario, and Lake Superior, referred to this species by Mr. Pearson * are probably something else. *Scapania Bolanderi* is strongly marked by the rigid oblong-obovate ventral lobes and by the coarsely dentate dorsal lobes, furnished at the base with long curved often branched cilia. These cilia often lie close to the stem and are covered by the dorsal lobe next below, so that a careful separation of the leaves from the stem is usually necessary for a satisfactory demonstration of this character.

The plant when growing in tufts of *Dicranum* is sometimes erect. We have rarely met with gemmiferous conditions. The original specimens were collected in California by Dr. Bolander, and were distributed by Mr. Austin as no. 19 of the Hepaticae Boreali-Americanae.

* List of Can. Hep. 13. 1890.

Unpublished figures of this species, drawn by Dr. Gottsche, are preserved in the Gray Herbarium at Cambridge, Mass. The sheet on which the figures are drawn bears the inscription "Scapania Californica G. MS.," in addition to the name given the species by Mr. Austin.

Scapania Bolanderi is reported from Japan by Herr Stephani, (Bull. Herb. Boiss. **5**: 82. 1897).

PLATES 106 AND 107. SCAPANIA BOLANDERI.

1. Plants, natural size.
2. Apical portion of a sterile plant, × 12.
3. Portion of a ♂ plant, showing position of androecia, × 12.
4. Ciliate margin of the base of the dorsal lobe, × 106.
5. Apex of ventral lobe, × 106.
6. Leaf, dorsal view, × 23.
7. Leaf, ventral view, × 23.
8. Young perianth and bracts, ventral view. × 12.
9. Perianth, bracts, and sporogonium, × 12.
10 and 11. ♂ bracts and antheridia, × 12.
12. Antheridia, × 53.
13. Antheridial paraphyses, × 106
14. Outline of a portion of perianth-mouth, × 53.
15 Leaf cells near apex of ventral lobe, × 305.

Figs. 1, 3, and 10–12, from no. 938 (Eureka); 2, 6 and 7, from no. 984 (Eureka); 4, 5, 8, 9, 14 and 15, from no. 596 (Mendocino); 13 from no. 928 (Eureka).

2. SCAPANIA NEMOROSA (L.) Dumort. Rec. d'Obs. Jung. 14. 1835.

Jungermannia nemorosa L. Sp. Pl. **2**: 1132. 1753.

Brownish or olive-green, usually in broad, compact cushions: stems rather rigid, 1–6 cm. long, sparingly branched, ascending, with the apex more or less decurved: leaves somewhat stiff, approximate or slightly imbricate, increasing a little in size upward, irregularly ciliate-dentate, more or less evidently winged along the fold, the ventral margin decurrent; ventral lobes 2–2.5 times larger than the dorsal, obovate, convex, obtuse, apex and ventral margin commonly deflexed; dorsal lobes reniform or broadly and obliquely ovate, rounded at apex or with a short point, usually a little vaulted, the margin somewhat appressed; leaf-cells nearly uniform, oval-quadrate, thick-walled, cuticle roughened: gemmae sometimes abundant at stem-apex and on margins of upper leaves, yellowish-brown, oval, unicellular or uniseptate, 15–24 μ × 15 μ occasionally in moniliform threads: dioicous: androecium terminal, ♂ bracts scarcely different, antheridia 2–6, accompanied by numerous long, multiseptate, simple or branched, hair-like para-

physes, brown trichomes of a similar structure sometimes occurring on other parts of the stem: perianth long-obovate, 2–3.5 mm. × 1.5–2 mm., now and then subplicate, ciliate-dentate at mouth: capsule ovoid-oblong, brown, seta 5–15 mm. in length; spores 12–16 μ, punctulate; elaters contorted, 100–180 μ × 7–10 μ.

On rocks and moist banks. Mt. Tamalpais (21, ♂ and gemmiferous); Lake San Andreas (1192, *c. fr.*) San Mateo Co.; near Cazadero (1191, *c. fr.*), Sonoma Co.; Crescent City (Mr. Thomas Howell), Del Norte Co. A few slender gemmiferous plants from near Lake Lagunitas, Marin Co., appear to belong with this species also, though the dorsal lobes are commonly squarrose and the teeth are shorter and less numerous than is usual.

The cuticle in the Californian specimens is for the most part distinctly granulate or verruculose, often as much so as in a specimen of *Scapania aspera* Müller & Bernet * collected and determined by Loitlesberger and in another collected and determined by Pearson, but we are unable as yet to distinguish *Scapania aspera* from *S. nemorosa.* A specimen collected by Loitlesberger in "Saminathal (Vorarlberg) 800 m." and named by him *Scapania nemorosa* has its leaf-cells more decidedly scabrous than has either of these specimens which have been referred to *Scapania aspera.*

3. SCAPANIA OAKESII Aust. Bull. Torr. Bot. Club, 3: 10. 1872.

Light-green, brownish, or fuscous-purple, caespitose: stems somewhat rigid, sparingly branched, ascending, 1–2.5 cm. long: leaves tense or a little flaccid, approximate or close, crowded and larger at apex in ♀ plants, alate-carinate, the carina in the upper leaves, especially the involucral, broad and furnished with a single or sometimes a double series of long, usually curved, teeth, these wanting or infrequent in ♂ plant, ventral margins decurrent; ventral lobes obliquely obovate or rhombic-trapezoidal, 2–2.5 times greater than the dorsal below, subequal at the apex, convex, obtuse or sometimes slightly pointed, serrate-dentate; dorsal lobes round-ovate, scarcely imbricate except at stem-apex, convex, obtuse or subacute, the upper often unicalcarate-dentate at basal margin, the teeth otherwise rather smaller and less numerous than in the ventral lobes: marginal and median leaf-cells quadrate-oval, 15–24 μ, oblong-hexagonal near the base, 30–56 μ × 16–18 μ, trigones inconspicuous, cuticle plainly roughened: sometimes gemmiferous at stem-apex or on margins of the upper leaves, gemmae mostly

* Bernet, Cat. Hep. du Sud-Ouest de la Suisse et de la Haute-Savoie, 42. 1888.

unicellular, spherical or oval, 15–20 μ, occasionally in branching moniliform threads: dioicous: ♂ and ♀ plants mingled or in separate tufts, ♂ plants more slender: androecium terminal, ♂ bracts smaller, approximate or rather distant, more rarely subimbricate, ventricose, lobes nearly equal, the dorsal often calcarate-dentate at base, antheridia 2–6, accompanied usually by a very few short capillary or sometimes leaf-like paraphyses: perianth oblong or obovate, truncate, denticulate or subentire at the mouth.

On moist banks. Mendocino (590, ♂); near Eureka [945, 946 (*c. per.*)] and Kneeland Prairie Road (1025), Humboldt Co.

Scapania Oakesii, as represented in Austin's Hep. Bor.-Am., no. 14, and in two other specimens from herb. Austin in herb. Underwood (all from the White Mountains of New Hampshire) is a large plant evidently very closely related to *Scapania undulata purpurea*. Our plants are usually smaller, more copiously subciliate-dentate on the carina, and have more resemblance superficially to *S. nemorosa*, yet are certainly distinct from either of the species named. They accord very closely with Dr. Scouler's specimens from Observatory Inlet, in herb. Torrey, which Austin made var. ♂ of *Scapania Oakesii*. In some of the Eureka plants the carina is richly provided with teeth as far as the seventh or eighth pair of leaves from the stem-apex.

PLATES 108 AND 109. SCAPANIA OAKESII.

1. Plants, natural size.
2. Perianth and bracts, ventral view, × 12.
3 and 6. ♂ plants, × 12, the former gemmiferous at apex.
4. Apical portion of a ♀ plant, dorsal view, × 12.
5. Perianth and bracts, dorsal view, × 12.
7. ♂ bract and antheridia, × 23.
8. Antheridium, × 53.
9. Antheridial paraphyses, × 106.
10 and 11. Leaves from near the stem-apex of a sterile ♀ plant, × 23.
12. Leaf, ventral view, × 23.
13. Leaf from lower part of stem, carina entire, × 23.
14. ♀ bract, × 23.
15. Leaf-cells from near apex of ventral lobe, × 305.
16. Portion of perianth-mouth, × 53.
17. Margin of apex of ventral lobe, × 106.

Figs. 1, 3, 4, 6–13, 15, and 17, from no. 946 (near Eureka); 2, 5, and 14, from no. 945 (near Eureka); 16, from no. 1025 (Kneeland Prairie Road).

4. SCAPANIA UNDULATA (L.) Dumort. Rec. d'Obs. Jung. 14. 1835.

Jungermannia undulata L. Sp. Pl. 2: 1132. 1753. Hook. Brit. Jung. *pl. 22.* 1816.

Green, rose-red, or dark purple, rarely brownish, in compact or loose tufts: stems rather rigid, usually erect, sometimes floating, 1–10 cm. long, sparingly branched, with very few root-hairs, denudate and brittle below: leaves larger and imbricate at apex, approximate or distant below, mostly soft and flaccid, usually undulate-crisped or crumpled in drying, entire, denticulate, or ciliate-dentate, slightly alate-carinate, carina entire; ventral lobes round-trapezoidal, mostly twice the size of the dorsal, subequal toward the stem-apex, sometimes broadly pointed, decurrent, convex or nearly flat; the dorsal lobes equally broad, obliquely and broadly ovate, with a rather obtuse point, loosely incumbent or somewhat bent away from the stem: leaf-cells near the margin quadrate or oval, 15–20 μ, oblong-hexagonal in the middle, 45–60 $\mu \times$ 15–30 μ, mostly thin-walled, cuticle more or less distinctly hyaline-roughened: dioicous: perianth oblong or more rarely obovate, slightly narrowed at the entire, repand, or subdentate mouth.

On stones in streams and springs or in very moist places, especially in mountainous regions.

North Fork of the Little River, Mendocino Co., on submerged rocks (600). No. 649, from the same locality but growing on a log just above the water-line appears to be a variety approaching *S. nemorosa* in the subciliate-dentate upper leaves and in the form and relative size of the lobes, having, however, the subentire perianth mouth of *S. undulata.* No. 639, sterile, from wet rocks in stream-bed seems to agree with the latter, as does also a specimen collected in the region of the Yosemite Valley by C. M. Cooke, Jr., in 1896 (*ex dono* A. W. Evans). Also collected in California by Dr. Bolander, the exact locality unknown.

Scapania uliginosa (Sw.) Dumort., so far as we know, has not yet been collected in California, but its discovery there may be expected. It differs from *Scapania undulata* chiefly in the smaller, reniform, strongly convex dorsal lobes, much narrower than the ventral lobes and $\frac{1}{4}$–$\frac{1}{3}$ their size, and in the always entire leaves decurrent on both sides, especially long-decurrent on the ventral margin.

Scapania irrigua (Nees) Dumort. differs from *S. undulata* in the softer, weaker stems, bearing root-hairs to the apex, in the

thinner, softer, less decurrent leaves, with nearly orbicular lobes, of which the convex dorsal is ⅓–½ the size of the ventral and sharply pointed, the ventral commonly with a short point.

5. SCAPANIA UMBROSA (Schrad.) Dumort. Rec. d'Obs. Jung. 14. 1835.

Jungermannia umbrosa Schrad. Syst. Samml. Krypt. Gew. **2**: 5. 1797. Schrad. Jour. Bot. 1801: 67. 1803. Hook. Brit. Jung. *pl. 24.* 1816.

Jungermannia convexa Scop. (?) Fl. Carn. **2**: 349. 1772. [2d ed.]

Martinellia convexa Lindb. Musc. Scand. 6. 1879.

Scapania convexa Pearson, List Can. Hep. 15. 1890.

Yellowish-green to brown, sometimes tinged with purple, in an extended, closely appressed, usually compact stratum: stems 5–15 mm. long, branching or subsimple, ascending, decurved at apex especially when dry: leaves increasing somewhat in size upward, not decurrent, bilobed ½–⅔ their length, the fold rounded or acute, sometimes with a trace of a winged keel; ventral lobes 2–3 times larger than the dorsal, oblong-ovate, acute or subacuminate, irregularly serrate-dentate toward apex, deflexed and often somewhat secund; dorsal lobes ovate, acute, sometimes narrowly pointed, dentate, nearly parallel to the stem, appressed-imbricate, except in slender sterile conditions: leaf-cells small, roundish-oval, 12–27 μ, more elongated toward base, thick-walled, trigones distinct, cuticle minutely roughened: gemmae in dark-brown clusters at stem-apex, mostly uniseptate, oblong-elliptical, 18×9 μ: dioicous: androecium terminal, antheridia 1–3 in axils of smaller, saccate, nearly equal-lobed leaves, accompanied by a few short, usually septate hairs: perianth oblong, from an obconic base, 1.2–2 mm.×.6–1 mm., twice as long as the involucral leaves, often purple at base, compressed, mouth entire or repand: capsule oval-oblong, dark-brown, long-exserted; spores brown, punctulate, 10 μ; elaters 125–165 μ×7–8 μ.

Exsicc. Hep. Am. 191.

On old logs beside shaded streams, North Fork of the Little River, Mendocino Co. (647, 683) and Eureka, Humboldt Co. (961); also on compact argillaceous soil in the first-named locality (686). No. 711, from a log in Russian Gulch, near Mendocino, which we formerly (Erythea **5**: 89. 1897) referred to *Scapania glaucocephala*, we now believe to be an abortive, gemmiferous con-

dition of *Scapania umbrosa.* Collected by Professor Macoun on Mt. Mark, Vancouver Island.

Our plants appear to agree with the European in all the more important details, yet the marginal teeth of the leaves are rather larger and more numerous than in most of the European specimens examined, the cuticle less distinctly roughened, the dorsal lobes a little less closely imbricated, and the perianth is sometimes longer.

It is very probable, as was first pointed out by Lindberg,* that *Jungermannia convexa* Scop. is identical with *J. umbrosa* Schrad., though the perianths ("*thecae*") were described by Scopoli as oval, and dentate at the apex, while those of *Scapania umbrosa* are oblong, with an entire or repand mouth. We have been informed by Prof. Briosi that the Scopoli collection is not preserved at Pavia and as we have been unable to locate it, we prefer to retain for this species a name concerning the correct application of which we can have no doubts.

6. SCAPANIA CURTA (Mart.) Dumort. Rec. d'Obs. Jung. 14. 1835.

Jungermannia curta Mart. Fl. Crypt. Erlang. 148. *pl. 4. f. 24.* 1817.

Bright- to dark-green, sometimes brownish, loosely gregarious or in thin mostly inconspicuous mats: stems ascending, 4–15 mm. long, .1–.35 mm. thick, simple or innovating above: leaves rather soft, usually increasing in size toward the stem-apex, bilobed to about the middle, the fold outwardly rounded or acute, rarely with a trace of a wing; ventral lobes 2–3 times larger than the dorsal, orbicular-ovate to obovate, acute, apiculate, or obtuse, entire or sparingly dentate, patent-horizontal, slightly or not at all decurrent, a little concave ventrally; dorsal lobes deltoid- or quadrate-ovate, erecto-patent to patent-horizontal, acute, entire or slightly dentate, ascending, never appressed-imbricate; leaf-cells translucent, roundish-hexagonal, 16–36 μ, becoming oblong toward the base, the walls with small trigones, cuticle nearly smooth; gemmae in a dense cluster at the stem-apex or borne on the margins of the upper leaves, brownish or colorless, ovoid to oblong-ellipsoidal, 24 × 16 μ, simple or uniseptate: dioicous: androecium terminal, antheridia single or in groups of 2 or 3: perianth long-obovate, 1.8–3.5 × 1–1.8 mm., the mouth shortly ciliate-dentate, rarely repand.

* Musc. Scand. 6. 1897.

On a log by a stream near Sisson, Siskiyou Co. (38), in company with *Riccardia latifrons*, *Chiloscyphus polyanthus*, and *Cephalozia media*. Only a few scattered gemmiferous shoots were found, yet we feel little hesitancy in referring them to *Scapania curta*, concerning the distribution of which in America little is at present known. The specimens agree closely with Rab. Hep. Eur. 93 ("*a* communis, 1. forma sterilis") though the leaf-cells are somewhat larger. The gemmae are broader than is usual in European forms, judging from the specimens accessible; only in G. & R. Hep. Eur. 382, have we found anything to equal the measurements given above.

7. SCAPANIA HETEROPHYLLA M. A. Howe, Bull. Torr. Bot. Club, **25**: 183. *pl. 336*. 1898.

Plants obscurely complanate, dark green, often bleaching at apices on drying, erect or ascending, forming compact cushions: stems 4–6 cm. high from a rhizomatous base, rigid, fastigiately and subdichotomously branched, brown, becoming almost black, nearly or wholly destitute of root-hairs, denudate below, 20–30 cells in thickness: leaves scarcely increasing in size upward, sometimes smaller at the stem-apex, the upper erecto-patent, subimbricate, the lower approximate, more spreading, often with squarrose tips, all strongly undulate-crisped both when moist and when dry, bilobed to the middle or bipartite, complicate, the carina acute or somewhat rounded, but never winged, commonly bistratose toward the base near the fold, the lobes sometimes almost disunited; now and then with an unlobed leaf irregularly interpolated, most frequently in the position of an underleaf; margins of the lower leaves commonly erose, of the upper entire or sparingly denticulate; ventral lobes twice as large as the dorsal or subequal, 1.7–2.5 mm. in length, .85–1.6 mm. in maximum width, broadly obovate, elliptical, or obovate-oblong, usually decurrent, mostly rounded-obtuse at apex; dorsal lobes obtuse, obliquely and broadly ovate or elliptical, not decurrent, sometimes appressed at stem-apex, especially on the younger shoots, but mostly ascending or slightly squarrose-reflexed: leaf-cells generally opaque, with smooth or slightly roughened cuticle, near the margin subquadrate or roundish-hexagonal, 16–28 μ, near the base oblong, 60–90 μ × 25–30 μ; trigones indistinct or wanting: remaining parts unknown.

Exsicc. Hep. Am. 192.

On submerged stones in a cold mountain stream (alt. 3000 ft.)

in company with *Chiloscyphus polyanthos rivularis* and *Porella rivularis*, Sisson, Siskiyou Co., July, 1894 (no. 34).

The stream, which is formed by a great spring beside the railway track about three fourths of a mile north of the village of Sisson, is said to maintain nearly a uniform volume throughout the year, and as plants were found wholly under water in the last of July and the first of August, it is probable that their submersion is permanent.

The above species was referred at first, uncritically, to *Scapania undulata* and listed under that name in Erythea (**4**: 49. 1896). From *S. undulata*, however, it is certainly very distinct in the obscurely complanate branches, in the sometimes 3-ranked, often more deeply lobed, erecto-patent, never alate-carinate, leaves, with more or less squarrose tips, and in the obovate rather than round-trapezoidal ventral lobes. The interpolated unlobed leaves stand sometimes in about the general position of dorsal or ventral lobes, but more often squarely subtend the ventral surface of the stem. They can doubtless be explained in some cases, from the point of view of ontogeny, by the separation of the normally united lobes, but in other cases this hypothesis seems to find little justification. We have noticed one or two *three*-lobed leaves out of hundreds examined and in such the complete disjunction of the most ventral lobe would have thrown it nearly into the place of an underleaf. When the leaf-lobes are subequal it is often difficult to distinguish between the dorsal and ventral aspects of the stem, especially if further confused by the presence of the supernumerary entire leaves. From stems of such a character as this, however, may spring young shoots in which the leaves are regularly distichous and acutely complicate, in the ordinary *Scapania* fashion, with the ventral lobes twice the size of the dorsal. In the axils of the upper leaves are sometimes to be found numerous short clavate paraphyses, unicellular or of two or three oblong cells in a lineal series.

We are indebted to Herr K. Loitlesberger for pointing out (*in lit.*) that the leaves of our plant are "two cells thick in the middle," a texture which he has never found in submerged *Scapania undulata*.

It is possible that the species deserves to be separated generically from *Scapania*, but in absence of perianth and sporogonium, we can do no better than refer it to a genus with which it surely has very much in common.

PLATE 110. SCAPANIA HETEROPHYLLA.

1. An entire plant, ½ the natural size.

2 and 3. Opposite views of a portion of the stem, showing the often three-ranked leaves, × 15.

4. Dorsal view of stem and leaves, × 15.

5. Ventral view of the same object, showing an unlobed underleaf, × 15.

6. The leaf with lobes "a" and "a¹" already shown in figures 4 and 5.

7. A typical underleaf, × 15.

8. Outline of a deeply lobed leaf, × 15.

9. Apex of a branch of the same plant from which figures 4 and 5 were drawn; leaves here distichous, × 15.

10. The leaf "d" from the foregoing, × 15.

11. Ventral view of a leaf, × 15.

12. Cells from near base of leaf, × 244.

13. Cells from the apical margin of one of the upper leaves, × 244.

14. Paraphyses from axils of leaves, × 244.

15 Cross-section of the stem, × 32.

33. RADULA Dumort. *p.p.* Comm. Bot. 112. 1822.

Martinellius S. F. Gray, *p.p.* Nat. Arr. Brit. Pl. 1: 690. 1821.

Stephanina O. Kuntze,* Rev. Gen. Pl. 839. 1891. Schiffn.; Eng. & Prantl, Nat. Pflanzenfam. 1^3: 113. 1895.

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* Dr. Otto Kuntze evidently errs somewhat in asserting that the original *Radula* of Dumortier (1822) was an equivalent of the *Martinellius* of S. F. Gray (1821), inasmuch as Gray's *Martinellius* contained a fourth generic element, viz., the *Adelanthus* of Mitten (*Martinellius decipiens* S. F. Gray), which did not appear in the original *Radula*, even though it was given a place in the *Radula* of 1831. Now, by the "method of residues"—which seems to us a natural and logical mode of settling the descent of names originally applied to generic composites—it is clear that after Dumortier, under the name of *Radula*, had removed the modern *Radula*, *Scapania*, and *Plagiochila* elements from Gray's tetrameric genus *Martinellius*, the *Adelanthus* component was left, which would thus fall heir to the name imposed by Gray. This would seem to us a particularly happy circumstance in view of the fact that the later name *Adelanthus* was earlier used in a different sense by Endlicher. Again, by the "method of residues," the name *Radula*, after the excision in 1833 and 1835 of the *Scapania* and *Plagiochila* elements from the *Radula* of 1822, descends to the genus which has borne the name *Radula* with nearly every hepaticologist since 1833. By "priority of place," too, the name *Radula* would descend in the same way inasmuch as *R. complanata* was always the first species mentioned by Dumortier and was apparently always more or less clearly in his mind as the type of the genus. But the general application of the "priority of place" principle would result in attaching S. F. Gray's name *Martinellius* to this same species as has already been pointed out by Dr. Carrington and others.

The use of *Radulum* by Fries in 1825 for a genus of fungi cannot disqualify Dumortier's *Radula* of 1822. If either name should disappear, it is the *Radulum* of Fries.

Plants moderately large, rarely small and slender, green or yellowish-green, tinging the water a yellowish-green when soaked out, in most species creeping and forming at length wide depressed mats. Stems rather loosely pinnate or subbipinnate, very rarely dichotomous; the branches infrafoliar in origin. Leaves alternate, incubous, conduplicate-bilobed, the lobes mostly very entire, the ventral lobe smaller, often somewhat inflated near the fold, its free margin nearly always appressed to the dorsal lobe; leaf-cells small, chlorophyllose, often containing "oil-bodies." Root-hairs always springing from a mammilliform outpocketing of the ventral lobe near its base. Underleaves everywhere wholly wanting. Mostly dioicous, in a few species paroicous or autoicous. Androecia in dioicous species amentiform, usually terminal on main stem or the principal branches; the ♂ bracts 3–35 pairs, equitant, with subequal lobes; antheridia single or less commonly in 2's or 3's. Archegonia several, acrogenous, very rarely cladogenous, the matured perianth sometimes pseudolateral through the development of a "subfloral" innovation. ♀ bracts a single pair, often a little smaller than the leaves, the somewhat enlarged ventral lobe without root-hairs. Perianth in most species strongly compressed dorso-ventrally, in a few subterete, very rarely carinate or plicate, the mouth broad from the beginning, somewhat bilabiate, the truncate lips entire or repand-crenate. Calyptra narrowly obovoid or elongate-pyriform, rather firm and subopaque, its walls composed of 2 or 3 layers of cells.

Capsule mostly oval-cylindrical, 2–3 times as long as broad, 4-valved to the base, the valves bistratose, the longitudinal walls of the exterior cells with moniliform or nodular thickenings, the much thinner interior cells usually with delicate transverse striae. Seta short and stout. Spores large, subglobose or ellipsoidal, minutely granulate-papillate or subechinulate. Elaters long and slender, obtuse, closely spiral.

Key to the Species.

Dioicous; androecia linear, amentiform; dorsal leaf-lobes obovate, the inner margin adnate to stem, not surpassing it, leaf-cells 9–16 μ; spores subglobose or ellipsoidal, 48–60 μ in maximum diameter. 1. *R. Bolanderi.*

Paroicous; dorsal leaf-lobes quadrate-orbicular, the inner margin surpassing the stem, leaf-cells 16–24 μ; spores subglobose, 30–38 μ. 2. *R. complanata.*

1. RADULA BOLANDERI Gottsche; Steph. Hedwigia, **23**: 145. 1884.

Radula spicata Aust. Bull. Torr. Bot. Club, **6**: 19. 1875. Pearson, List Can. Hep. 4. *pl. 4.* 1890. Not *Radula spicata* Mitt. Bonplandia, **10**: 19. 1862.

Light-green, slender, creeping, becoming intricately caespitose: stems 1–2 cm. long, pinnately or somewhat bipinnately branched, the branches mostly short: leaves contiguous or laxly imbricate, patent or erecto-patent, subascending, the obtuse carina arcuate and decurrent; dorsal lobes obovate, .35–.85 mm. long, .27–.65 mm. wide, nearly plane or slightly concave, almost longitudinally adnate to the stem, which the inner margin does not surpass, apex very obtusely rounded; ventral lobes of the leaves on the younger ramuli subequal to the dorsal lobes or one half as large, those of the adult leaves one third the size of the dorsal, inflated, rhomboidal-ovate, the obtuse or subacute apex more or less appressed to the dorsal lobe, the inner margin almost wholly adnate to the stem and scarcely incumbent, the outer margin obliquely truncate; leaf-cells 9–16 μ, the walls scarcely thickened at the angles: dioicous: androecia terminal on main stem or principal branches, numerous, linear, 3–7 mm. long, .5–.6 mm. wide, usually directed downward; ♂ bracts 10–35 pairs, very closely imbricated, strongly ventricose, the lobes equal: ♀ bracts of about the same size as the leaves, the lobes subequal: perianth obconic, 1.2–2 mm. long, .75–1.2 in greatest width, bilabiate, the lips entire: capsule prolate-ellipsoidal, exserted 1–2 mm., the valves about 1 mm. long, transverse striae of the inner cells very obscure or wanting; spores subglobose or ellipsoidal, 48–60 μ in maximum diameter, minutely and densely echinulate-papillate; elaters 150–200 μ × 6–8 μ.

On the trunks of trees (*Alnus*, *Umbellularia*, etc.). Common in the Coast Range Mountains—at least, from San Francisco northward; Mill Valley, Marin Co.; Cazadero, Sonoma Co.; Mendocino (549); Eureka (918) and near McBride's, Mad River (1051), Humboldt Co. Vancouver Island (Macoun).*

2. RADULA COMPLANATA (L.) Dumort. Comm. Bot. 112. 1822.

Jungermannia complanata L. Sp. Pl. 1133. 1753.

Mostly yellowish-green, rather flaccid, closely and radially creeping, finally forming depressed mats: stems 1–6 cm. long, irregularly pinnate: leaves closely imbricate, patent, the margins occasionally gemmiferous; dorsal lobes quadrate-orbicular, .5–

* There seems to be little or nothing in the description and figure of Herr Stephani's apparently wholly sterile *Radula arctica* (from Chlowak and Chilcoot, Alaska.—Bot. Jahrb. 8: 98. *pl. 3. f. 11.* 1886) to distinguish it from the juvenile condition of *Radula Bolanderi*.

1.6 mm. long by .4–1.5 mm. wide,* concave ventrally with the obtuse apex more or less deflexed, or nearly plane, the inner margin surpassing the stem; carina slightly arcuate; ventral lobe about one fourth the size of the dorsal, subquadrate, now and then a little elongated in a direction parallel to the carina, appressed to the dorsal lobe throughout or lightly inflated toward the base, subobtuse or acute, the inner superior angle free and somewhat incumbent upon the stem; leaf-cells 16–24 μ, the walls distinctly thickened at the angles: paroicous: perigonial leaves 2–4 pairs, immediately subtending the ♀ bracts, ventricose at base, the ventral lobes obtuse, ⅓–½ the size of the dorsal: ventral lobes of the ♀ bracts subequal to the dorsal or one half as large, obtuse: perianth obconic or elongate-obconic, 1.8–3 mm. long by .7–1.2 mm. in maximum width, strongly compressed, bilabiate, the lips entire or slightly repand: capsule prolate-ellipsoidal or obovoid, .9–1.3 mm. × .45–.55 mm., exserted about 1 mm.; spores subglobose, 30–38 μ, finely granulate-papillate; elaters 160–210 μ × 6–9 μ.

On branches and trunks of trees in moist or deeply shaded places (the species inhabits rocks also, but has not yet been found in such situations in California); Berkeley, Fruit Vale (Miss Byxbee); near Olema, Marin Co.; near Mendocino (707); Eureka (917) and Blue Lake (1015), Humboldt Co.; collected in California by Dr. Kellogg and probably also by Dr. Bolander, though we have seen no specimens of the latter's collecting.

It seems to us to be doubtful whether *Radula Krausei* Steph. (Bot. Jahrb. **8**: 97. *pl. 3. f. 10.* 1886)—at least as represented in Hep. Am. 149, a portion of which, we understand, was submitted to Herr Stephani before its distribution—can be satisfactorily distinguished from *R. complanata.* If we are not mistaken, the supposed distinctive characters of *Radula Krausei* pass quite imperceptibly into those of the Pacific coast *R. complanata,* which, we believe, cannot be well separated from the European plant.

34. PORELLA L. Sp. Pl. 1106. 1753. Ex Dill. Hist. Musc. 459. *pl. 68.* 1741. Lindb. Act. Soc. Sci. Fenn. **9**: 335. 1869.

Bellincinia Raddi, Atti Soc. Ital. Sci. Mod. **18**:—(7): 1818. Mem. Mat. e Fis. Soc. Ital. Sci. Mod. **18**: 18. 1820.

* The dorsal leaf-lobes of *Radula complanata* are said by Herr Jack (Flora, 64: 356. 1881) to be always broader than long, but we do not find them always so even in a specimen collected near Salem by Jack and Leiner. In the Californian specimens here referred to *R. complanata*—as well as in the North American plant in general—the leaves are ordinarily a little longer than broad.

Antoiria Raddi, Atti Soc. Ital. Sci. Mod. 18:—(8): 1818. Mem. Mat. e Fis. Soc. Ital. Sci. Mod. 18: 19. 1820.

Cavendishia S. F. Gray, Nat. Arr. Brit. Pl. 1: 689. 1821.

Madotheca Dumort. Comm. Bot. 111. 1822. Nees, Naturgesch. Eur. Leberm. 3: 157. 1838.

Plants large, dark-green to yellowish-brown, mostly somewhat regularly bi- or tri-pinnate, rarely subsimple; root-hairs in tufts at the base of the underleaves, usually sparingly developed. Leaves very deeply 2-parted; the dorsal lobes large, incubous, obliquely orbicular-ovate to oblong, entire, repand or somewhat dentate; ventral lobes much smaller than the dorsal, sometimes nearly discrete, ovate, lingulate, oblong, linear, or lanceolate, nearly parallel with the stem, entire or toothed, margins plane or revolute. Underleaves large, somewhat similar in form to the ventral lobes but usually broader, entire or dentate, often long decurrent on both sides. Antheridia spherical, very short-stalked, single in the axils of saccate, densely imbricate, nearly equally bilobed opposite leaves, these connate with the underleaves and forming short, lateral, oval, to linear-oblong spikes. Archegonia generally numerous, terminal on very short (most rarely a little elongated) lateral branches. Perianth oval to obovate, flattened dorso-ventrally toward the mouth, from a more or less obconical base, much longer than the bracts, two-lipped after elevation of the capsule or sometimes irregularly torn, mouth ciliate, dentate, or subentire. ♀ bracts usually a single pair with a single bracteole in addition to the underleaf at the base of the branch, the latter underleaf united with the subtending cauline leaf and functioning as its ventral lobe, or free, leaving the cauline leaf unlobed. Capsule spherical to ovoid-oblong, on a short seta, yellowish-brown, opening, usually not quite to the base, by four often irregularly split valves; cell-walls of the valves mostly with irregular nodulose thickenings. Elaters commonly 2-(1–3-) spiral; spores several times broader, more or less echinulate.

Key to the Species.

Stems subsimple or somewhat fasciculately branching, short, tumid; underleaves caudate-lacinulate at base; perianth-mouth ciliate. 1. *P. Bolanderi.*

Stems more or less regularly 1–3-pinnate.

Usually shining.

Ventral lobes more or less spurred outwardly at base, mostly linguiform or ovate-oblong, margins plane or lightly recurved. 3. *P. Roellii.*

Ventral lobes regularly rounded outwardly at base, ovate, margin recurved. 4. *P. navicularis.*

Usually dull; rather flaccid, dorsal lobes subimbricate, ventral lobes long-decurrent, underleaves distant. 2. *P. rivularis.*

1. PORELLA BOLANDERI (Aust.) Pearson, List. Can. Hep. 7. 1890.
[Excluding specimens cited (?)]

Madotheca Bolanderi Aust. Bull. Torr. Bot. Club, 3: 14. 1872.

Dark- or yellowish-green, dull: stems 1.5–6 cm. long, subsimple or with a few somewhat fasciculately disposed obtuse tumid branches, often subpendulous, more or less vaulted or flexuous when dry: dorsal lobes of leaves densely imbricate, appressed or subsquarrose, dimidiate-ovate to oblong, 1.5–2.9 mm. × .67–1.8 mm., sometimes considerably narrowed toward the obtuse apex, slightly decurved when moist, circumvolute-deflexed in drying, rather distinctly margined by somewhat inflated subrectangular cells, the inferior margin more or less undulate, often narrowly inflexed, the superior repand or here and there caudate-dentate, the base long drawn out and projecting beyond the stem, trigones small; ventral lobes and underleaves approximate or more often imbricate, sometimes entirely concealing the stem; ventral lobes ovate-lanceolate to linear-lanceolate, rarely almost subulate, acute or occasionally somewhat obtuse, subfalcate, canaliculate, slightly twisted, long-decurrent, nearly discrete, .4–1 mm. × .08–.4 mm., about ½ as wide as the underleaves, length ⅖–⅗ the width of the dorsal, undulate-repand above, sparingly caudate-lacinulate on inner side at base, often also on the outer: underleaves ovate-lingulate to oblong, a little wider than the stem, apex obtuse, subacute, rarely emarginate or slightly cleft, often deflexed, margins plane or recurved, undulate-repand, long-decurrent, the wings with commonly 2 or 3 cauda-like laciniae on either side toward the base: dioicous: ♂ spikes oblong to almost linear, 2–4 mm. in length: ♀ branch short; dorsal lobes of ♀ bracts subobtuse or acute, the ventral acute or often subulate-pointed, margins of both subentire or denticulate above, ciliate-caudate at base, bracteole large, ovate, usually acute, denticulate above, caudate-lacinulate below; underleaf subtending ♀ branch acutely emarginate or bifid; perianth broadly ovate from a shortly obconic base, somewhat compressed, lightly undulate-plicate dorsally, often furnished ventrally with 2 or three rarely winged carinae, narrowed at the ciliate, subtruncate, deeply bilabiate mouth: capsule oval or oval-oblong, exserted by about its own length; spores 29–40 μ, minutely echinulate; elaters 180–310 μ × 10–12 μ, 2- (3-) spiral.

EXSICC. Hep. Am. 31.

On stones, under shelving rocks, and on the bark of living trees, especially of *Quercus agrifolia*.

First collected by Dr. Bolander. Berkeley (7, 1189, 1190, 1197), Fruit Vale (1219), San Leandro (Underwood); Mitchell

Cañon, Mt. Diablo (1195, 1196, 1218); Ukiah (756), Pieta (797), Mendocino Co.; near Hay Fork (1108), Trinity Co.; Oak Run and Cow Creek, Shasta Co. (M. S. Baker and F. P. Nutting); Nordhoff, Ventura Co. (Miss Jacqueline K. Newton); Pasadena and Elsinore (A. J. McClatchie).

Type in herb. Pearson, Knutsford, Cheshire, England. We have seen no specimens of *Porella Bolanderi* from any station outside of California. Can. Hep. no. 10 (distributed as *P. Bolanderi*) is, so far as we have seen it, *Porella rivularis*—in one pocket mixed with *P. navicularis*. Can. Hep. no. 11 (issued as *Porella Bolanderi* var.), from Mt. Benson, Vancouver Island, is *Porella Roellii* Stephani.

In moist, densely shaded places, *Porella Bolanderi* assumes a more lax, flaccid habit, resembling certain forms of *P. rivularis*. Such conditions, however, when the characteristic ciliate perianths are wanting, can usually be distinguished from any state of *P. rivularis* by the more oblong, more distinctly marginate, dorsal leaf-lobes, and by the longer and narrower ventral lobes and underleaves, which are more pronouncedly caudate at the base.

PLATES 111 and 112. PORELLA BOLANDERI.

1–3. Plants, ♀, natural size.
4. Plant, ♂, natural size.
5. Portion of plant, ventral view, × 12.
6. Mature perianth and part of stem, ventral view, × 12.
7. Young perianth, bracteole, bracts, etc., ventral view, × 12.
8. Half of mouth of young perianth, × 53.
9 and 10. Transverse sections of perianth, the lower side ventral, × 23.
11–13. Cauline leaves, showing the ventral lobe, × 23.
14. Leaf and ventral lobe, × 12.
15–17. Leaves, dorsal view, × 12.
18 and 19. Underleaves, × 23.
20. Leaf-cells, × 305.

Figs. 1 and 2 from specimen collected in Fruit Vale by Miss Byxbee; 3, 5, 14, 16, 17, and 20, from no. 1190 (Berkeley); 4, from no. 1189 (Berkeley); 6 and 12, from no. 1196 (Mt. Diablo); 7–10, 13, 15, and 19, from no. 7 (Berkeley); 11 and 18, from no. 1195 (Mt. Diablo).

2. PORELLA RIVULARIS (Nees) Trevis. Mem. r. Ist. Lomb. III. **4**: 407. 1877.

Madotheca rivularis Nees, Naturgesch. Eur. Leberm. **3**: 196. 1838.

Porella dentata Lindb. Act. Soc. Sci. Fenn. 9 : 342. 1869.

Dull, or very rarely a little polished, opaque, commonly dark green, sometimes yellowish, mostly soft and flaccid: stems irregularly pinnate or subdichotomous, 3–10 cm. long, prostrate or ascending, forming loose or more dense mats, branches somewhat obtuse, scarcely diminishing in width toward apex: dorsal lobes of leaves usually subimbricate or approximate, sometimes distant, rarely closely incubous, obliquely ovate to orbicular-ovate, rounded-obtuse, 1–2 mm. × .8–2 mm., entire or subdenticulate, flat or slightly concave beneath, only a little decurved at the apex, trigones mostly small; ventral lobes small, obliquely ovate, acute, .35–.7 mm. × .12–.4 mm., length $\frac{1}{3}$–$\frac{2}{5}$ the width of the dorsal, about one half as broad as the underleaves, margins, especially the outer, for the most part broadly revolute, often giving the lobe a twisted appearance, long decurrent, usually dentate or subciliate at base internally and sometimes unindentate externally but scarcely spurred: underleaves distant, quadrate, orbicular to broadly ovate, about twice the width of the stem, apex rounded-obtuse, sometimes reflexed, margins repand-undulate, very long decurrent, the wing sometimes exceeding the free portion in length and usually acutely dentate or subciliate: dioicous: ♂ spikes oval to oblong, 1.5–2.5 mm. in length: ♀ branch short: ventral lobes of the single pair of ♀ bracts acute or subobtuse, entire or repand, the dorsal obtuse, bracteole ovate-linguiform, repand; perianth ovate, with lateral margins deflexed, deeply bilabiate, the lips subentire or repand-dentate, usually plane: spores 27–45 μ, papillate-echinulate; elaters 180–290 μ × 8–10 μ, rather obtuse, 2(3-) spiral.

Exsicc. Hep. Am. 150 (as *Porella Roellii*, var.), 194A, and 194B.

On moist rocks, stones in streams, and bases of trees in densely shaded places. Widely distributed and extremely variable according to habitat.

Near Berkeley (7d, 7e, 19, 1175, 1182, 1214); Mill Valley and Olema (1178); Cazadero (1179); Mendocino (714, 718); Ukiah (745); Blue Lake (1177); Russ & Graham's Ranch (1084) Humboldt Co.; Sisson, Siskiyou Co., (1176); Cow Creek and Burney Falls, Shasta Co. (M. S. Baker & F. P. Nutting); Yosemite Valley region (C. M. Cooke, Jr.). Collected in California by Dr. Bolander also, the exact localities unknown, and by Mr. S. B. Parish in the southern part of the state.

Our determination is based upon the drawing (accompanying G. & R. Hep. Eur. no. 371) of the original plant from the bed of

the river Bober, near Hirschberg, Silesia, and upon European specimens and the descriptions of authors.

The name *dentata*, applied by Hartman in 1832 (Skand. Fl. 354, 2d ed.) to what he considered a variety of *Jungermannia platyphylla* was taken up for the above species by Lindberg in 1869, but was abandoned by him ten years later without explanations. Hartman's description of his variety *dentata* is quite inadequate for its proper identification and as we have failed in our efforts to see his original specimens, if such exist, we prefer to adhere to the first name which was accompanied by an intelligible diagnosis.

3. PORELLA ROELLII Steph. Bot. Centralb. **45**: 203. 1891.

Green or yellowish-brown, usually shining: stems procumbent, rather flaccid, densely depressed-caespitose, 4–8 cm. long, subdichotomous below, the primary branches for the most part simply and remotely pinnate, branchlets short, often attenuate-deflexed: dorsal lobes of leaves densely imbricate, appressed, obliquely ovate, patent-divergent, .85–1.7 mm. × .65–1.5 mm., apex narrowed, subtruncate, obtuse, or most rarely apiculate, inferior margin more or less undulate-crisped, the superior repand, cells at basal angles slightly smaller, all with evident trigones; ventral lobes ovate, linguiform or ovate-oblong, usually much narrowed toward the obtuse or subacute apex, suberect or patent, scarcely connate with the dorsal, commonly about ½ as wide as the underleaves, length ⅔ the width of the dorsal, somewhat concave ventrally, margins plane or slightly recurved, a little decurrent, very rarely dentate above, more or less strongly spurred at the base, especially at the outer angle, the spur entire or dentate, rarely subciliate: underleaves approximate, ovate-linguiform, rounded-obtuse, the margins recurved, long-decurrent, entire or most rarely subdentate, the wings sometimes crisped: dioicous: ♂ spikes 1–2 mm. long: ♀ branch somewhat elongated, bearing 3–8 leaves (or "bracts") (usually 2 pairs) nearly similar to the cauline; inmost bracts a little larger, the lobes subacute, entire, repand-dentate, or sparingly denticulate, bracteole ovate, subentire or denticulate; perianth large, somewhat goblet-shaped or broadly obovate, undulate-concave ventrally, here and there inflated, scarcely narrowed or lobed at the wide truncate dentate mouth, the oral margins plane or slightly deflexed at the sides.

Under shelving rocks and on moist shaded cliffs, rarely on tree-trunks. Mill Valley (1168) and Mt. Tamalpais (1171), Marin

Co.; near Cazadero (1170), Sonoma Co.; Ukiah (759) and Navarro (Miss Edith S. Byxbee), Mendocino Co.; Blue Lake (994) and Deer Creek (1068, 1073, 1231), Humboldt Co.; Hay Fork (1109), Trinity Co.

Type from Kitchelos Lake, Washington (Roell, June 12, 1888) —in herb. Stephani, Leipsic. Type duplicate in herb. Underwood.

Porella Roellii is closely related to the forms of the European *P. laevigata* with obtuse dorsal lobes and subentire ventral lobes and underleaves, as represented, for example, in Carrington and Pearson's no. 275 Hep. Brit. Exsicc., from Scotland. This is especially true of British Columbia specimens (Macoun: Cascades, Yale, May, 1875; no. 63, near Victoria, May 30, 1893), and of our no. 1068. These latter differ, however, from *P. laevigata* in the smaller, narrower, more pointed, and more strongly calcarate ventral lobes, and in the usually more slender fronds. They are forms like these, we take it, that have been referred by Mr. Pearson * to *P. laevigata*, but in the predominating forms in Washington, Oregon, and California the plant is much less suggestive of *P. laevigata*, and we prefer to maintain Stephani's species, and to associate with it the British Columbia specimens alluded to and our no. 1068, even though, as must be admitted, they make a near approach to certain conditions of the European plant. Perianths occur only in our nos. 994 and 1231; they appear to differ but slightly from those borne by a specimen of *P. laevigata* from Teneriffe, which we owe to the kindness of Matthew B. Slater, Esq., of Malton, England.

PLATES 113 AND 114. PORELLA ROELLII.

1. ♀ plant, natural size.
2 and 3. Sterile plants, natural size.
4. ♂ plant, natural size.
5. Portion of plant, ventral view, × 12.
6–8. Cauline leaves, showing ventral lobes, × 23.
9. Rameal leaf, ventral view, × 23.
10 and 11. Underleaves, × 23.
12 and 13. ♀ branches, with bracts and mature perianths, × 12.
14. Outline of cauline leaves, dorsal view, × 12.
15. Leaf-cells, × 305.
16 and 17. Leaves, viewed dorsally, × 12.

* List of Canadian Hepaticae, 7. 1890.

18. About one fourth of perianth-mouth, × 53.

Figs. 1, 12, 13, and 18, drawn from no. 994 (Blue Lake, Humboldt Co.); 2, from no. 759 (Ukiah); 3, from no. 1109 (Hay Fork, Trinity Co.); 4, from no. 1168 (Mill Valley); 5, 6, 8–10 and 14–17, from a portion of the original material collected by Roell at Kitchelos Lake, Washington, and communicated to Professor Underwood by Herr Stephani; 7 and 11, from no. 1068 (Deer Creek, Humboldt Co.).

4. PORELLA NAVICULARIS (Lehm. & Lindenb.) Lindb. Act. Soc. Sci. Fenn. **9**: 337. 1869.

Jungermannia navicularis Lehm. & Lindenb.; Lehm. Pugill. **6**: 38. 1834.

Madotheca navicularis Nees, *p. p.* G. L. N. Syn. Hep. 277. 1845.

Madotheca Douglasii Tayl. Lond. Jour. Bot. **5**: 379. 1846.

Madotheca Californica Hampe, in herb. Sullivant, *fide* Austin, Hep. Bor.-Am. 91.

Shining or more rarely dull, brownish-yellow, large: stems somewhat regularly bipinnate, 4–12 cm. long, procumbent-caespitose, or subpendulous with apices ascending when moist, branchlets gradually narrowed, subacute, convex on drying and slightly deflexed: dorsal lobes of leaves densely imbricate, appressed, for the most part closely wrapped about the stem when dry, obliquely orbicular-ovate to oblong-ovate, 1.2–2.5 mm. × 1–1.8 mm., rounded-obtuse, apex decurved, subcucullate, inferior margin slightly undulate-crisped, the superior decurrent, its wing sometimes laciniate-crispate, otherwise very entire, the inferior basal angle composed of numerous small thick-walled cells ¼–½ the diameter of the remainder, trigones conspicuous throughout; ventral lobes ovate, obtuse, most rarely subacute, regularly rounded outwardly at base, .5–1 mm. × .33–.75 mm., a little smaller than the underleaves, length somewhat more than ½ the width of the dorsal, margins entire, recurved, decurrent, apex often deflexed: underleaves approximate, quadrate-oblong, rounded-obtuse, margins entire, recurved, long-decurrent, apex occasionally deflexed: dioicous: ♂ branches oval to oblong, 1½–2½ mm. in length: ♀ branch short, lobes of the single pair of bracts minutely denticulate or entire, the ventral usually acute, the dorsal obtuse, bracteole wide; perianth broadly obovate from an obconic somewhat inflated base, scarcely narrowed above, deeply bilabiate, the lips at first subciliate-denticulate, later obsoletely crenulate-dentate or nearly entire, strongly revolute, giving perianth the appearance of being squarely or obliquely truncate: capsule ovoid, yellowish-brown, exserted by about its own length; spores 50–85 μ, echinu-

late, bright yellowish-green; elaters 275–325 μ × 9–10 μ, obtuse, 2-(3-) spiral.

EXSICC. Hep. Bor.-Am. 91.

Hep. Am. 30.

Common on trunks and branches of trees and more rarely on rocks throughout the Pacific Coast from California to Alaska; as far east as Idaho (Leiberg); Mexico (*fide* Gottsche).

Mill Valley (1215), Olema (1216, 1217); Duncan's Mills (1180), Cazadero (1181), Sonoma Co.; Mendocino (563, 564), Navarro (Miss Edith S. Byxbee), Ukiah (776); Mission Hills, San Francisco (Dr. Kellogg); Lake Pilarcitos, San Mateo Co. (W. C. Blasdale); Santa Cruz Mts. (Underwood). Collected in California also by the botanists of Beechey's expedition (in herb. Taylor), by Dr. Bolander and others.

The original specimens were collected by Menzies on the western coast of North America, exact locality unknown. Lindenberg's specimen of "*Jungermannia navicularis* n. sp." is preserved in the Naturhistorisches Museum at Vienna. We are indebted to Prof. Dr. G. von Beck for the privilege of seeing a portion of this type. The European plants referred by some authors to *Porella navicularis* probably all belong with *P. platyphylla* or *P. laevigata*. This species in a fertile condition can always be very easily distinguished from any simulating form of *P. platyphylla* by the broadly obovate perianth, scarcely narrowed at the mouth, and by the twice larger diameter of the spores. When sterile, if more obvious characters fail, the numerous, small, thick-walled cells filling the inferior basal wing of the dorsal lobe are of importance; these are ¼–½ the diameter of the cells in the middle of the lobe while in *P. platyphylla* the cells are nearly of a uniform size throughout the lobe or slightly smaller at the basal margin.

In two cases, we have observed a peculiar modification of *Porella navicularis* due, we believe, to the influence of an epiphytic fungus. The leaves were here *bilobed* rather than *bipartite*, the union of the lobes resembling that of *Lejeunia* or *Radula*. The ventral lobes were shortened so that their longer axis was nearly parallel to that of the dorsal lobe and were conspicuously inflated as in most of the *Lejeuniae*. The underleaves were also shortened and often ventricose. In fact, when, as sometimes happened, a

sterile plant was thus transformed throughout, there was little, outside of the axillary branching, to distinguish it from the holostipous *Lejeuniae*. The inflated cavities of the ventral lobes and sometimes also those of the underleaves were mostly occupied by one or more yellowish or colorless subspherical bodies, 40–120 μ in diameter, probably sporangia of a fungus belonging to the order *Chytridiales*, perhaps to the genus *Rhizophidium* Schenk. At maturity, the contents of some of the globose bodies become resolved into numerous minute ovoid colorless masses, 4–6 μ in diameter. In both of the cases where the *Porella* was thus affected it was growing in company with species of *Radula* (*Radula complanata*, near Mendocino, no. 707, and *Radula Bolanderi*, near McBride's, Mad River, Humboldt Co., no. 1051).

PLATES 115 AND 116. PORELLA NAVICULARIS.

1 and 2. Plants, ♂ and ♀, natural size.
3. Portion of ♀ plant, viewed ventrally, × 12.
4–7. Leaves, showing ventral lobes, × 12.
8 and 9. Underleaves, × 23.
10. Outline of cauline leaves, dorsal view, × 12.
11. ♀ branch, with young perianth, bracts, bracteole, etc., ventral view, × 21.
12. Mature perianth, ventral aspect, and sporogonium, × 12.
13. Inferior basal margin of dorsal lobe, × 25.
14 and 15. Leaves, dorsal aspect, × 12.
16. One half of mouth of young perianth, × 53.
17. Leaf-cells, × 305.

Figs. 1, 7, and 15 drawn from no. 776 (Ukiah); 2, 3, 6, 8, 11, 12, 14, and 16, from no. 564 (Mendocino); 4, 5, 9, and 10, from no. 1215 (Mill Valley).

35. FRULLANIA Raddi, Atti Soc. Ital. Sci. Mod. **18**:—(9). 1818. Mem. Mat. e Fis. Soc. Ital. Sci. Mod. **18**: 20. 1820. Spruce, Trans. and Proc. Bot. Soc. Edinb. **15**: 3. 1884.

Plants large or small, depressed-caespitose, mostly reddish-brown, less commonly green or nearly black. Stems moderately stout, opaque, composed of several layers of small cells, pinnately ramose, the branches all lateral, each arising exactly in the axil of a cauline leaf, from which it is always free; root-hairs springing in tufts from the bases of the underleaves. Leaves alternate, somewhat obliquely or almost transversely inserted, complicate-bilobed; the dorsal lobes incubous, obliquely ovate to suborbicular, nearly always entire; ventral lobes (lobules) usually developed as inflated galeate, cucullate, cylindrical-clavate, or rarely digitiform water-sacs, or sometimes evolute, more or less distant from the stem,

commonly bearing near the base on the side toward the stem a small or minute, subulate or triangular process (stylus); lobule of the leaf subtending a branch mostly explanate and almost equally bifid; leaf-cells mostly small to medium-sized, with more or less conspicuous trigones at the angles and sometimes also with intermediate lateral thickenings. Underleaves always present, considerably smaller than the leaves, bifid (very rarely entire). Dioicous or autoicous (rarely paroicous). Androecia usually occupying short lateral branches, globose to oblong; ♂ bracts saccate, closely imbricate, about equally 2-lobed; antheridia 2–4. Archegonia usually 2–4, very rarely as many as 12, acrogenous or cladogenous, "subfloral" innovations always wanting. ♀ bracts 2–5 pairs, larger than the leaves, free from the perianth, the two of the inmost pair (in extra-limital species) occasionally connate with the bracteole and with each other to form a gamophyllous exciple; lobules evolute, subentire or more or less dentate, ciliate, or laciniate; bracteole often connate with one or both of the inmost bracts. Perianth free, commonly emersed, more or less compressed dorsoventrally, trigonous in cross-section with the third angle ventral or sometimes tetragonous with two ventral angles, often bearing in addition several shorter supplementary dorsal or ventral folds or ridges, otherwise smooth or in a few species roughened by tubercles, contracted at the apex to a tubular rostellum, irregularly ruptured by the exsertion of the capsule. Calptra free, included, pyriform or obovoid, fleshy. Capsule globose, exserted on a short seta, dehiscing by four valves for about ⅔ the distance from the apex to the base, the valves composed of two layers of cells, those of the outer layer rather large and thick, with strong columnar thickenings (appearing nodular in surface view) at the angles and in the lateral walls, those of the inner layer smaller and thinner, more or less papilliform, their boundaries obscured by irregular thickenings; the basal uncleft portion of the capsule-wall made up of several layers of thin-walled colorless cells. Seta scarcely exceeding the perianth or 2–3 times longer, stout, 8 or 9 cells in diameter, with cells alternate (*i. e.*, seta not appearing articulate in surface view), abruptly dilated above to form the base of the capsule. Elaters rather few, stout, unispiral, persistently affixed to the upper half of the capsule-valves, the free ends truncate or with a trumpet-like expansion. Spores large, papillate or verruculose.*

* The North American species of *Frullania* have been admirably figured and described by Dr. Alexander W. Evans (Trans. Conn. Acad. 10: 1–39. *pl.* 1–15. May, 1897). The following descriptions of the Californian species are taken with but slight modifications from Dr. Evans' paper.

Key to the Species.

Lobules galeate (when inflated), about as broad as long; perianth terminal on the main stem or a leading branch.

Dioicous, flagelliferous; lobules (excepting those of bracts and of leaves subtending branches) always inflated, slightly longer than broad. 1. *F. Bolanderi.*

Autoicous, flagella wanting; lobules, when inflated, broader than long, very often evolute. 2. *F. Catalinae.*

Lobules oval-cylindrical to short-clavate, 1¼–2½ times as long as broad; dioicous; perianth terminal on a rather short lateral branch.*

Dorsal lobes of the leaves rounded-obtuse to acuminate-apiculate, usually (but not always) marked with a short median line of slightly enlarged discolored cells; lobules separated from the stem by about their own width; underleaves mostly rhombic-obovate, gradually narrowed to the base and without a trace of an auricle, the margins plane, often bluntly unidentate on either side. 4. *F. Franciscana.*

Dorsal lobes of the leaves rounded-obtuse, discolored cells scattered or wanting; lobules separated from the stem by less than half their width; underleaves subquadrate-orbicular, more or less auriculate at base, the margins plane or slightly recurved at the sides. 3. *F. Californica.*

Dorsal lobes of the leaves acute or more commonly acuminate-apiculate, discolored cells scattered or wanting, rarely in a short median line; lobules separated from the stem by about their own width; underleaves suborbicular or reniform, auriculate at base, the margins strongly recurved at least toward the apices. 5. *F. Nisquallensis.*

I. Subgenus TRACHYCOLEA Spruce.

1. FRULLANIA BOLANDERI Aust. Proc. Acad. Nat. Sci. Philad. 1869: 226. 1869. Evans, Trans. Conn. Acad. **10**: 8. *pl. 2.* 1897.

Frullania Petalumensis Gottsche; Bolander, Cal. Med. Gaz. 1870: 184 (40) (name only). 1870.

Frullania Hallii Aust. Bull. Torr. Bot. Club, **6**: 20. 1875.

Dark green, varying to reddish-brown, closely appressed, diffusely repent or caespitose: stems 6–20 mm. long, .07–.14 mm. in diameter, irregularly pinnate, the branches often prolonged into erect or ascending flagella, these crowned at the apex with a few small well-developed leaves but furnished otherwise only with patent-horizontal or subsquarrose underleaves and the merest rudiments of lateral leaves: dorsal lobes of leaves mostly subimbricate, ascending when moist, obliquely ovate or semiorbicular, .35–.5 mm. × .27–.45 mm., arching over the stem and subtruncate at base, entire, the slightly decurved apex rounded-obtuse; lobules large, galeate, .23–.32 mm. × .2–.27 mm., truncate at base, close to the

* While the three Californian species of this section are closely allied and have long been confused, they are nevertheless entirely distinct. The credit of finally disentangling and defining them belongs largely to Dr. Evans.

stem; stylus small, lanceolate or subulate: underleaves distant, rhombic-obovate or somewhat orbicular, slightly exceeding the stem in width, bifid about one third their length with mostly subacute lobes and sinus, margins plane, entire or bearing one or two teeth at the sides: superior and median cells of the dorsal lobes 18–30 μ, all rather thick-walled, trigones small or conspicuous, intermediate thickenings very rarely developed: dioicous: androecia ovoid to oblong, ♂ bracts in 4–15 pairs: archegonia 3 or 4, terminal on the main stem or a leading branch: ♀ bracts in two or three pairs, gradually two or three times larger than the leaves, unequally bifid, the dorsal lobes ovate, rounded-obtuse, entire or slightly repand; lobules ovate or lanceolate, obtuse or subacute, plane or lightly concave ventrally, entire except for a small tooth (stylus) near the middle of the inner margin: bracteole connate on one or both sides, ovate or oblong-ovate, commonly bifid $\frac{1}{4}$–$\frac{1}{3}$ its length with acute lobes and sinus but sometimes rounded at apex or merely emarginate, rarely 3- or 4-dentate: perianth about half-emersed, obovoid, 1.2–1.6 mm. × .8–1.3 mm., with a rather broad, usually two-angled ventral keel and one or more supplementary ventral and dorsal ridges, very rarely with a few scattered tubercles, the beak short and broad and usually flaring at the mouth: capsule exserted by about its own diameter; spores variable in form and size, mostly 40–60 μ in greatest diameter.

Exsicc. Hep. Bor.-Am. 105b.
Hep. Am. 28.

On the bark of living trees (*Quercus*, *Alnus*, *Umbellularia*, *Aesculus*, etc.). Very common, especially in the Coast Range counties. Berkeley, Fruit Vale, and San Leandro (Prof. L. M. Underwood, June, 1888), Alameda Co.; Mission Dolores (Bolander), San Francisco; Tomales (Bolander) and Mill Valley, Marin Co.; Kenwood (Mr. F. T. Bioletti), Sonoma Co.; Mendocino (Bolander); Blue Lake (1004), Humboldt Co.; Mt. Diablo, Contra Costa Co.; Monterey (Prof. W. G. Farlow, May, 1885) and Pacific Grove, Monterey Co.; San Gabriel Mountains, near Pasadena (Prof. A. J. McClatchie, June 1, 1893). The species extends northward to British Columbia.

2. FRULLANIA CATALINAE Evans, Trans. Conn. Acad. **10**: 11. *pl. 4*. 1897.

Reddish-brown, sometimes tinged with green, depressed-caespitose: stems 5–15 mm. long, .1–.18 mm. in diameter, irregularly pinnate: dorsal lobes of leaves imbricate, squarrose or semivertical

when moist, obliquely ovate, .45–.7 mm. × .4–.62 mm., arching over the stem and subtruncate at base, entire, the slightly decurved apex rounded-obtuse; lobules inflated and broadly galeate, .16–.18 mm. long, .2–.27 mm. wide, separated from the stem by about one fourth their width, or very often imperfectly inflated or wholly explanate, then ovate-linguiform, .18–.3 mm. long, .1–.18 mm. wide; stylus subulate, minute: underleaves distant or contiguous, plane, broadly rhombic or rhombic-obovate, mostly 1–2 times the width of the stem, bifid ⅓–½ their length, with obtuse or subacute lobes and sinus, entire or more commonly unidentate on the sides: superior and median cells of the dorsal lobes 16–30 μ, all with slightly thickened walls, small trigones, and no intermediate thickenings: autoicous: androecium small, ovoid, occupying a short branch springing from near the involucre, ♂ bracts 1–3 pairs: archegonia about 6, terminal on the stem or the principal branches; ♀ bracts in two or three pairs, gradually larger than the leaves, unequally bifid, the dorsal lobes ovate, entire or subcrenulate toward the base, obtuse; lobules shorter and narrower, ovate, obtuse or subacute, bearing a single distinct tooth or segment slightly above the middle of the inner edge, otherwise entire: bracteole oblong or narrowly ovate, connate on one side with bract, bifid for ⅓ or more of its length, with lanceolate parallel or somewhat divergent lobes, otherwise entire or sometimes unidentate toward the base of the free margin: perianth about half-exserted, broadly fusiform to obóvoid-pyriform, 1.4–1.8 mm. × .75–1.1 mm., with a distinct two-angled ventral keel and one or more less pronounced dorsal and ventral ridges, gradually narrowed to a short broad beak: spores 30–40 μ in greatest diameter, thickly and minutely granulate-papillate.

On rocks in a cañon, Santa Catalina Island (Professor A. J. McClatchie, Sept. 8, 1893).

II. Subgenus THYOPSIELLA Spruce.

3. FRULLANIA CALIFORNICA (Aust.) Evans, Trans. Conn. Acad. **10**: 25. *pl. 12. f. 11–22.* 1897.

Frullania Grayana Californica Aust. *p. p.*; Underw. Bull. Ill. State Lab. Nat. Hist. **2**: 67. 1884.

Frullania Asagrayana Californica Aust. (*ch. emend.*), M. A. Howe, Erythea, **2**: 98. 1894.

Frullania Asagrayana alsophila M. A. Howe, Erythea, **2**: 99. 1894.

"*Frullania Tamarisci* Nees, ?"; Bolander, *p. p.* Cal. Med. Gaz. 1870: 184 (40). 1870. Not *Frullania Tamarisci* (L.) Dumort.

Green, reddish-brown, or fuscous, densely depressed-caespitose or rather laxly repent: stems light brown or greenish, 1–3 cm. long, .1–.22 mm. in diameter, once or twice pinnate: dorsal lobes of leaves more or less imbricate, suborbicular, those of the main stem .45–.8 mm. × .35–.8 mm., all arching over the stem and cordate at base, entire, rounded-obtuse and somewhat decurved at apex, discolored cells scattered or wanting; lobules oval-cylindrical to short-clavate, .13–.22 mm. × .09–.13 mm., separated from the stem by less than half their width; stylus minute, subulate or disc-like: underleaves distant or approximate, subquadrate-orbicular, 1–3 times the width of the stem, more or less auriculate at base, bifid about ⅓ their length with mostly subacute lobes and narrow or broad sinus, margins entire, plane or slightly reflexed at the sides: superior and median cells of the dorsal lobes mostly 10–20 μ, all rather thick-walled, trigones inconspicuous and intermediate thickenings scanty: dioicous: androecia subglobose, ♂ bracts 2–5 pairs: archegonia terminal on a short branch: ♀ bracts in two or three pairs, unequally bifid, the dorsal lobes ovate or ovate-lanceolate, acute, entire; lobules lanceolate or subulate, acuminate, often canaliculate or tubulose by the recurving of the margins, sometimes falcate, bearing on the inner margin a laciniate lobe-like segment, otherwise entire: bracteole connate with the bract on one side, ovate, bifid to about the middle with subulate-acuminate or lanceolate-acuminate lobes and bearing on either side at the base a distinct usually laciniate segment, otherwise entire: perianth ovoid, 1.6–2 mm. × .9–1.2 mm., somewhat gradually or rather abruptly narrowed to the short beak, strongly unicarinate ventrally, smooth: mature sporogonium unknown.

EXSICC. Hep. Bor.-Am. 108, *p. p.* (distributed as *F. Nisqualensis*).

Hep. Am. 197.

On rocks, logs, and trunks of living trees. Mission Dolores (Bolander) and Clarendon Heights (Howe), San Francisco; Mill Valley and Olema, Marin Co.; Duncan's Mills (1209) and "Turner's Cañon," Sonoma Co.; "Wildcat Cañon," near Berkeley; near Lake Pilarcitos, San Mateo Co. (Blasdale); Pacific Grove, Monterey Co. There are in existence several additional specimens of Dr. Bolander's collecting, attributed simply to "California." The species extends as far north as Victoria, B. C., where it has been collected by Professor Macoun.

4. FRULLANIA FRANCISCANA M. A. Howe, Erythea, **2**: 99. *pl. 2.* 1894. Evans, Trans. Conn. Acad. **10**: 26. *pl. 13. f. 1–8.* 1897.

Frullania Grayana Californica Aust. *p. p.*; Underw. Bull. Ill. State Lab. Nat. Hist. **2**: 67. 1884.

Frullania unciflora Californica Gottsche; Bolander, Cal. Med. Gaz. 1870: 184 (40) (name only). 1870.

"*Frullania Tamarisci* Nees?"; Bolander, *p. p.* Cal. Med. Gaz. 1890: 184 (40). 1870. Not *Frullania Tamarisci* (L.) Dumort.

Reddish-brown, varying to greenish, forming wide depressed mats: stems 1.5–4 cm. long, .1–.2 mm. in diameter, light brown or greenish, mostly bipinnate; dorsal lobes of leaves imbricate, obliquely ovate, those of the main stem and principal branches .6–1 mm. × .45–.8 mm. all arching over the stem and cordate at base, usually marked with a short median line of discolored slightly enlarged cells, entire, the decurrent apex from rounded-obtuse to acuminate-apiculate; lobules oval-cylindrical to short-clavate, .18–.23 mm. × .1–.14 mm., separated from the stem by about their own width; stylus minute: underleaves distant, subquadrate-rhombic to obovate, mostly rhombic-obovate, usually 2–2½ times the width of the the stem, gradually narrowed to the neither auriculate nor appendiculate base, bifid about ⅓ their length with narrow sinus and obtuse lobes, the margins plane, usually bluntly unidentate near the middle: superior and median cells of the dorsal lobes mostly 16–25 μ, all rather thick-walled, trigones and intermediate thickenings becoming more conspicuous toward the middle and the base: dioicous: androecia subglobose or oval, ♂ bracts 3–7 pairs; antheridia in 3's: archegonia terminal on a short branch: ♀ bracts in commonly three pairs, unequally bifid, the dorsal lobes of the inmost pair ovate, acute or acuminate-apiculate or rarely obtuse, ciliate at the dorsal base, otherwise entire; lobules ovate or lanceolate, acute, slightly concave ventrally, ciliate at the ventral basal margin, otherwise entire: bracteoles connate with the bract on one side, ovate, bifid to about the middle with a narrow sinus and lanceolate acuminate lobes, ciliate at base, otherwise entire: perianth oblong-obovate, 1.5–2.3 mm. × .9–1.1 mm., abruptly short-rostrate, strongly unicarinate ventrally, smooth: capsule exserted by about twice its own diameter of .7–.8 mm., spores 60–80 μ in greatest diameter, the verruculae mostly aggregated in small circular patches.

Exsicc. Hep. Bor.-Am. 108, *p. p.* (distributed as *F. Nisqualensis*).

On tree-trunks and old fences, rarely on rocks. Common in the Coast Range Mountains from San Francisco northward. Mission Dolores (Bolander), on "metamorphic sandstone, San Francisco" (Bolander, Apr. 4, 1864), and Clarendon Heights (Howe), San Francisco; Mill Valley and Olema, Marin Co.; Mendocino (Bolander; Howe, 547, 548, 574, 579, 1210, 1211); Eureka (Bolander; Howe, 970). Collected by Dr. A. Kellogg also and by Dr. Bolander, without definite locality.

5. FRULLANIA NISQUALLENSIS Sulliv. Mem. Amer. Acad. II. **4**: 175. 1849. Evans, Trans. Conn. Acad. **10**: 21. *pl. 10.* 1897.

Reddish-brown, varying to yellowish-green, depressed-caespitose: stems 1.5–3 cm. long, .12–.27 mm. in diameter, usually dark-brown, mostly bipinnate: dorsal lobes of the leaves imbricate, obliquely ovate, those of the main stem and principal branches .63–1.3 mm. × .55–.9 mm., all arching over the stem and cordate at base, entire, the strongly decurved apex acute or more commonly acuminate-apiculate, discolored cells scattered or wanting or rarely in a short median line; lobules oval-cylindrical to short-clavate, .16–.24 mm. × .09–.14 mm., separated from the stem by about their own width; stylus usually minute and subulate: underleaves distant or contiguous, suborbicular or reniform, 1–3½ times the width of the stem, auriculate at base, bifid about ¼ their length with obtuse or sometimes apiculate lobes, the sinus rather broad and obtuse or subacute, margins entire, strongly recurved at least toward the apices of the mostly reflexed and often subcucullate lobes: superior and median cells of the dorsal lobes mostly 16–30 μ, all rather thick-walled, trigones and often intermediate thickenings becoming conspicuous toward the middle: dioicous: androecium ovoid, ♂ bracts 4–9 pairs: archegonia terminal on a short branch: ♀ bracts in about three pairs, deeply and unequally bifid, the dorsal lobes ovate or ovate-lanceolate, acuminate, entire, sinuous, or very sparingly dentate; lobules mostly subulate-acuminate, canaliculate or subtubulose by the recurving of the margins, often falcate or distorted, bearing on the inner side toward the base a small laciniate segment or a cluster of cilia: inmost bracteole connate with bracts on both sides or sometimes on one side only, ovate, bifid ⅓–½ its length with lobes similar to the lobules of the bracts, the margins ciliate or dentate toward the base: perianth long-ovoid, 2–2.5 mm. × .9–1.2 mm., rather gradually narrowed to the short beak, strongly unicarinate ventrally, smooth: capsule exserted by about

its own diameter of .7–.8 mm.; spores 60–100 μ in maximum diameter, verruculose.

On rocks and trunks of trees.

Clarendon Heights, San Francisco (Jan. 23, 1895); Duncan's Mills (1209, in part), Sonoma Co.; Mendocino (1223); Kneeland Prairie Road (1042), Humboldt Co., near Crescent City, Del Norte Co. (Thomas Howell, April, 1892). The species extends as far north as Vancouver Island (Macoun).

Class ANTHOCEROTES.

The class *Anthocerotes* (see page 9) comprises the single order *Anthocerotales* and the single family *Anthocerotaceae*.

ANTHOCEROTACEAE.

Gametophore a wholly leafless thallus, commonly flat, orbicular, or semiorbicular, more or less lobed or radiately dissected, sometimes subpinnate (*Dendroceros*), or ribbon-shaped and subdichotomously branched, with, or more frequently without, a well-defined costa, usually of several layers of cells, often with interior mucilage cavities, more rarely with intercellular air-spaces, without proper epidermis, but provided on the ventral surface, sometimes also on the dorsal, with inconspicuous clefts ("stomata," "mucilage-slits"), the thallus becoming through these infected with *Nostoc* colonies; cells with a single large chloroplast which commonly encloses the nucleus.

Sexual organs embedded in the thallus; antheridia arising endogenously, short-stalked, single or in groups of 2–4 (rarely more), occupying cavities separated from the dorsal surface by two layers of cells, the covering ruptured at maturity; walls of archegonium confluent with surrounding cells of the thallus, the neck-canal communicating with dorsal surface at maturity of the egg-cell. Special calyptra not differentiated. "Involucre" tubular, of several layers of cells, formed from archegonium-wall and adjacent cells of thallus, usually soon broken through at the apex by the elongating capsule and remaining as a sheath about its base, or (in *Notothylas*) irregularly torn by external agencies.

Sporogonium consisting of a pod-like, usually erect and much elongated capsule, a bulbous foot, and a short intervening zone occupied by a long-active meristematic tissue; capsule dehiscing, with rare exceptions, from the apex downward by two valves, its walls containing chlorophyll and in most species of *Anthoceros* bearing stomata, each with two crescentic guard-cells; a slender thread-like columella, surrounded throughout and covered at the apex by the spore-forming layer, probably always present, but sometimes early disintegrated and obscure. Spores more or less plainly tetrahedral, long adhering in fours, smooth, verrucose, papillate, or echinulate, ripening successively from apex of capsule downward; sterile cells from the archesporium single and subcubical at maturity, or, more often, elongated and forming heteromorphic, variously contorted, occasionally branched fila-

ments of 2–4 cells, sometimes (*Anthoceros* sp. and *Dendroceros*— in tropics and southern hemisphere) with one or more well developed spiral bands, or, more commonly (pseudo-elaters), with spiral thickenings rudimentary or wanting.

Three genera, *Anthoceros*, *Dendroceros*, and *Notothylas*, are ordinarily recognized, of which only the first is known to occur within our limits.

ANTHOCEROS L. Sp. Pl. 1139. 1753. Ex Mich. Nov. Pl. Gen. 10, *pl. 7. f. 1, 2.* 1729.

Thallus suborbicular, variously lobed or irregularly dissected, now and then somewhat ribbon-shaped and subdichotomous, of more than one layer of cells throughout, costa wanting, indistinct, or rarely prominent; monoicous, proterandrous, or sometimes dioicous (?)*; capsule erect, bivalved, much exceeding the involucre in length, usually very long, with stomata (in the North American species). Spores granulose-papillate, tuberculate, or echinulate, rarely nearly smooth; sterile cells (in all our species) without spiral thickenings.

Key to the Species.

Thallus with peduncled tubers from ventral surface. 1. *A. phymatodes.*
Thallus without ventral peduncled tubers.
  Spores fuscous or black. 4. *A. fusiformis.*
  Spores yellow.
    Spores with a few (8–15) crescentic verrucae on convex (outer) surface, or nearly smooth; thallus usually with marginal, sometimes peduncled, glandular-thickenings. 2. *A. Pearsoni.*
    Spores thickly granulose-papillate. 3. *A. Carolinianus occidentalis.*

1. ANTHOCEROS PHYMATODES M. A. Howe, Bull Torr. Bot. Club, 25: 12. *pl. 324, 325.* 1898.

Thallus dark green, blackening on drying, dissected; the segments dichotomous, oblong or linear in sterile plants, broader in the fertile, 4–10 mm. × .5–2.5 mm., prostrate or very slightly ascending at the apices, at first radiate, becoming later intricately entangled, narrowly canaliculate dorsally, with ascending sinuate or repand margins, obtuse, carinate with a broad, thick, very distinct or sometimes obsolescent, naked or sparingly radiculose costa, this occupying nearly the whole of the narrower segments and sending down here and there a fleshy or elongated and slender process (.1–.4

* Certain species of *Anthoceros* have been described as dioicous, yet in a genus of which the best known representatives are proterandrous, and in which the archegonia are observed with so much difficulty, it may be suspected that careful investigation, by modern methods, would show proterandry to obtain in all.

mm. in thickness), terminated by a globose or ellipsoidal tuber, the latter .25–1 mm. in diameter, pale when living, yellowish-brown on drying, becoming finally closely covered with root-hairs; thallus 10–16 cells thick in region of costa, passing gradually or rather abruptly into the more or less extended 5–3-stratose marginal lamina; surface-cells rhombic to rhombic-oblong, 33–66 μ × 20–33 μ, indistinct after drying: involucres separate, cylindrical, 1.7–2 mm. × .5 mm., smooth, truncate, entire or slightly repand at the mouth.

On compact soil in a nearly level open plot about fifty feet north of "The Old Mill," Mill Valley, Marin Co., California (Howe: Mar. 19, 1892, and Feb. 22, 1896; the latter, which bears the involucres, we consider the type). Also collected by Dr. Bolander at "Oakland, on slides near the bay." The few capsules that have been seen are very immature, projecting only about 1 mm. beyond the mouth of the involucre, and it is quite possible that the description of the involucre given above will need some modification on the discovery of fully ripened sporogonia.

It is practically certain that this species is, in part, at least, what Austin referred provisionally to *Anthoceros caespiticius* De Not. (Bull. Torr. Bot. Club, **6**: 26. 1875), drawing his description, however, "from a specimen in herb. Torrey under the name *A. laevis* Linn., from the Island of Corsica." We had thought to take up for *A. phymatodes* the specific name *Torreyi* Aust. MS., which appears in parenthesis after *A. caespiticius* in the place cited, but an examination of the Austin collection, so generously loaned by Mr. Pearson, showed the manuscript diagnosis of *A. Torreyi* affixed to a scrap of the Corsican plant (which we refer to *Anthoceros dichotomus* Raddi) and that plant alone alluded to at the close of the description. *A. Torreyi* Aust. MS. is therefore a synonym of *A. dichotomus* and not of *A. phymatodes*. Bolander's specimen is accompanied by a slip of brown paper on which is written—evidently by himself—"Oakland on slides near the bay," but it is found in the Austin collection glued to Austin's manuscript description of *A. Lescurii* from New Orleans, the evident type of which appears in the same collection under the name of *A. Ludovicianus*.

Anthoceros phymatodes is a near ally of *A. dichotomus* Raddi, specimens of which from Raddi's herbarium we have had the

privilege of examining through the kindness of Professor Massalongo, as well as specimens from Portugal and Italy, obligingly communicated by Herr Stephani. But *A. dichotomus* has a costa 1/8–1/3 the width of the segment, 6–10 cells thick, the lamina mostly 2-stratose, involucre .7–1 mm. wide, often enlarged at the irregularly 2–4-lobed mouth; while *A. phymatodes* has a costa 1/3–3/8 the width of the segment, 10–16 cells thick, the marginal lamina 5–3-stratose, involucre .5–.6 mm. wide, not expanded at the entire or repand mouth. To facilitate further comparison, when the mature sporogonia are found, it may be added that in *A. dichotomus* from Raddi's herbarium ("*Anthoceros polymorphus* Raddi γ *dichotomus* Raddi" is the legend the packet bears) the capsules are erect or slightly curved, 7.5–15 mm. long, often thickened toward the apex, spores yellow, becoming yellowish-brown, rounded-tetrahedral, almost wholly smooth on all faces, 42–60 μ in maximum diameter, pseudo-elaters yellowish, of 1–4 irregular elongated cells, geniculate, variously contorted, often branched.

Anthoceros caespiticius DeNot., the probable original of which (from the vicinity of Cagliari, in southern Sardinia), we have been allowed to study through the indulgence of Professor Pirotta, is not closely related to *A. dichotomus*, with which it was compared by its author. It is a near ally of *Anthoceros punctatus* and may not be specifically distinct. The spores incline to be fuscous and are finely setose-papillate on the outer face and foveolate-reticulate on the inner faces; they are 40–45 μ in maximum diameter. The pseudo-elaters are practically as in *A. punctatus*. The involucres measure .65–1.1 mm. × .25–.5 mm. It is surely very different from the Californian plant, even though mature spores of the latter are wanting. The thallus apparently bears no tubers; it is thinner than in *A. phymatodes*, is quite indistinctly costate, and has the peculiar narrow ascending marginal shoots of *A. punctatus*. It is described by DeNotaris as being erect, while *A. phymatodes* is prostrate.

Anthoceros tuberosus Tayl., from Swan River, Australia (Drummond, 1873), we have examined through the courtesy of Dr. B. L. Robinson, Curator of the Gray Herbarium, in which the Taylor collection is incorporated. It differs from our plant in the much thinner, broader, scarcely costate thallus, the terminal or

marginal tubers, and the shorter somewhat obovate involucres. The spores are yellow, becoming brownish, sparingly warty-granulose, 35–45 μ; pseudo-elaters mostly of 1 or 2 elongated geniculate cells.

Anthoceros phymatodes differs from *Anthoceros Donnellii* Aust. in the larger, less numerous tubers on stouter stalks, also in the thicker, more opaque thallus, with less distinct surface cells, in the longer segments, etc.

The tubers of *A. phymatodes* are formed at the apex of the costa, but their peduncles become strictly ventral in their attachment by the continued onward growth of the segment. Two or three tubers successively older and larger as one passes backward may often be seen depending from a single branch. The tuber consists of a cortex of 2–4 layers of nearly empty cells enclosing a central mass of smaller cells so densely filled with oil drops or nearly colorless granules that the cell boundaries in a section are rendered obscure.

An interesting paper, "On the Structure and Contents of the Tubers of *Anthoceros tuberosus* Taylor" was published in the Memoirs and Proceedings of the Manchester [Eng.] Literary and Philosophical Society, vol. 41, no. 2 (1896) by Mr. J. H. Ashworth. Mr. Ashworth finds oil-drops and proteid granules in the interior cells of the tubers of this species. We have stated (Bull. Torr. Bot. Club, **25**: 14. 1898) that the granules in the tubers of *Anthoceros phymatodes*, in material preserved in alcohol, show a starch reaction with iodine, but further tests upon the same material either fail entirely to show the starch reaction or show it so obscurely that we must doubt the accuracy of our first observation. The granules mostly contain one or two more highly refringent portions, as described by Mr. Ashworth in *A. tuberosus*, and, on the application of iodine, they usually are stained a yellowish-brown or remain altogether unaffected.

PLATES 117 AND 118. ANTHOCEROS PHYMATODES.

1. Portion of the thallus, natural size.

2. Ventral view of a thallus segment, showing costa and tuber, × 23.

3–6. Lateral views of thallus segments, showing form and stages of development of tubers, × 23.

7 and 8. Old tubers, showing vegetative propagation by sprouting, × 23.

9. Longitudinal section through costa and young tuber, × 47.

10. Longitudinal section showing early stages in the formation of the tuber, × 47. The section is somewhat oblique and does not exhibit the full thickness of the costa.

11. Section through a well-grown tuber, × 53.

12. A single interior cell from fig. 11, × 305.

13. Longitudinal section through the costa, × 53.

14 and 15. Transverse sections of thallus segments, × 53.

16. Outlines of two other transverse sections of thallus segments, × 23.

17. Involucres, × 12.

Figs. 1–6 and 9–17 from specimen collected in Mill Valley, Marin Co., February 22, 1896—mostly drawn from material fixed with 1% chromic acid and preserved in alcohol; 7 and 8, from same locality, March 19, 1892.

18. Involucre of *Anthoceros polymorphus* Raddi, γ *dichotomus* Raddi, ex herb. Raddi, × 12.

2. ANTHOCEROS PEARSONI M. A. Howe, Bull. Torr. Bot. Club, 25: 8. *pl. 322, 323.* 1898.

Thallus smooth, prostrate or ascending, rarely erect, mostly irregularly dissected; the major segments linear or elongate-flabelliform, 5–20 mm. × 1–5 mm., often intertangled, sparingly lobed or two or three times subradiately dichotomous, plane or slightly concave, rarely costate ventrally at apices, in sterile plants usually 6–11 cells thick, gradually or abruptly reduced to three or four at the margin, in the fertile commonly expanded into a wide 3- or 2-stratose lamina with a lightly crisped periphery, the lobes in both often terminating in dark green, globose or difform, glandular-thickenings, .2–2 mm. in diameter, these sometimes long-peduncled, rarely descending and radicelliferous; surface-cells rather distinct, rhombic-trapezoidal to oblong, 20–70 μ × 20–30 μ, the inner larger but compact; *Nostoc* colonies usually abundant, ellipsoidal or fusiform: monoicous: involucres solitary or approximate in pairs, subterminal in erect forms, somewhat pellucid, mostly light green, elongate-cylindrical, 2.3–3.3 mm. × .5–.85 mm., sometimes decumbent at base, the mouth entire, repand-dentate, often lacerate with age, now and then scarious: capsule pale brown, yellowish, or drab, slender, sulcate, 8–32 (mostly 20–24) mm. × .24–.4 mm., rather thick-walled, the valves finally thin and often twisted, stomata abundant; columella filiform, naked; spores yellow, the convex face with a few (8–15) small, crescentic, rarely obsolete warts, otherwise smooth or most faintly granulose, 35–50 μ in maximum diameter; pseudo-elaters dilute yellow or occasionally tinged with brown, of 1–4 cells, geniculate and variously contorted, often branched, the cells 30–80 μ × 6–10 μ, with wall of nearly uniform thickness.

On moist banks and dripping rocks. Mill Valley (no. 16, May 7, 1892—the type—and 1205), Olema—also collected in

Marin Co., by Dr. Bolander and by T. S. Brandegee; Duncan's Mills (1198, 1200) and Cazadero (1199) Sonoma Co.; Mendocino (587, 702); Deer Creek Cañon, Russ and Graham's Ranch (1070) Humboldt Co.; near Douglas City (1202), Trinity Co.; Oak Run, Shasta Co. (Baker and Nutting); Mitchell's Cañon, Mt. Diablo (1201); Berkeley (1204); Palo Alto (Prof. D. H. Campbell); Santa Monica (Dr. H. E. Hasse); San Bernardino (Mr. S. B. Parish, 1731, 2220).

Anthoceros Pearsoni is the commonest yellow-spored *Anthoceros* of California, and perhaps of the Pacific Coast as a whole. We have seen as many as twenty specimens, ranging from southern California to Washington, and they are always very clearly distinct from *Anthoceros laevis* L., *A. Carolinianus* Michx., and *A. Hallii* Aust.; differing from the last-mentioned in having the capsule usually four times as long, in the much more perfect pseudo-elaters, composed of 1–4 elongated cells, in the spores being scarcely otherwise roughened than by 8–15 small crescentic verrucae, etc.; very different from both *A. laevis* and *A. Carolinianus*, in the character of the spore-markings, the spores of the two latter species being always thickly granulose-papillate. Sterile conditions can sometimes be only doubtfully distinguished from *A. Hallii*, but can be separated from glandular-thickened forms of *A. Carolinianus occidentalis* by the narrower segments and often pedunculed glands. The species is extremely variable in thickness and form of thallus, though very constant in spore-markings. In its thicker, slightly costate conditions, particularly when the glandular-thickenings are long-stalked, descending, and tuber-like, the thallus bears some resemblance to that of *A. phymatodes*, but in all such cases, we believe, the attachment of the tubers never becomes strictly ventral; their peduncles can, with care, always be traced back to the margins of the frond. The glands or tubers are 10–25 cells in thickness and consist of a more or less distinctly defined capsule of 1–3 layers of undifferentiated cells enclosing cells containing at first an unusually large chloroplast and later filled with oil-drops or densely crowded with whitish granules. These organs are evidently food reservoirs, adapting the thallus to persistence through the dry summers of the region that the plant inhabits. In the neighborhood of San Francisco the

thickenings begin to appear in January or February, attaining full development in May or June. In our no. 702, collected near Mendocino, California, these marginal thickenings often enclose numerous antheridia.

The above description of *Anthoceros Pearsoni* is based upon various specimens, but our no. 16, collected at Mill Valley, Marin County, May 7, 1892, from which the figures of the spores, pesudo-elaters and capsules have been drawn, we consider the type of the species.

PLATES 119 and 120. ANTHOCEROS PEARSONI.

1. Segment of the thallus, with mature sporogonia, natural size.

2, 3 and 4. Portions of a sterile thallus, showing its form, manner of branching and the beginnings of the marginal glandular-thickenings, natural size.

5. Marginal glandular-thickenings, fully developed, × 12.

6 and 7. Thallus segments with younger, sometimes peduncled, glandular-thickenings, × 12.

8. Ventral view, showing glandular-thickening bearing root-hairs, × 12.

9 and 10. Longitudinal sections through well-developed glandular-thickenings, the latter exhibiting embedded antheridia, × 53.

11. Transverse section of margin of the thallus, × 53.

12. Median longitudinal section of the thallus, × 53.

13–15. Involucres, × 12.

16. Pseudo-elaters, × 225.

17. Spores, × 305.

Figs. 1, 13, 16 and 17 from no. 16, Mill Valley, Marin Co. (the type); 2–4, near Duncan's Mills, Sonoma Co. (no. 1200); 5, 9, 10, 14 and 15, near Mendocino (no. 702); 6 and 7, Cazadero, Sonoma Co. (no. 1199); 8, Palo Alto (Prof. D. H. Campbell); 11 and 12, Mill Valley, Feb. 22, 1896.

3. ANTHOCEROS CAROLINIANUS OCCIDENTALIS M. A. Howe, Bull. Torr. Bot. Club, **25**: 8. *pl. 321.* 1898.

Thallus large, thin, ecostate, usually densely caespitose, ascending, now and then with margins and lobes glandular-thickened, light- or dark-green, a little pellucid or, on drying, opaque with a somewhat fatty lustre, dissected; major segments oblong or obovate, 1–3 times subdichotomously branched, 8–30 mm. × 2–7 mm., more or less widened at the rounded crenate apex, 4–8 cells thick in the middle, passing gradually into a wide 3- or 2-stratose margin, or nearly uniform throughout; surface-cells distinct in terrestrial forms, obscure in the aquatic, irregularly rhombic, becoming elongate-hexagonal, 20–120 μ × 18–30 μ: monoicous: involucres sometimes united in pairs, thick-walled, somewhat pellucid, long-cylindrical, 2–6.5 mm. × .5–1 mm., sometimes contracted or now

a little widened toward the thin, subentire or repand-dentate, rarely scarious mouth, often longitudinally plicate toward the base: capsule slender, 25–50 mm. × .25–.5 mm., pale brown, short-pedicellate, the valves twisted; spores yellow, thickly granulose-papillate, especially on the convex (outer) face, 35–56 μ in maximum diameter; pseudo-elaters nearly colorless to light yellowish-brown, of 1–4 cells, geniculate, often branched, the cells extremely variable in size and form.

On wet rocks and on the banks of rivulets near the water-line.

Olema (Jepson), Mt. Tamalpais, with *Fissidens grandifrons* (Howe, Setchell); Howell Mt., Napa Co. (Setchell); North Fork of Little River, Mendocino Co.; near Eureka, Humboldt Co.; Santa Cruz Mts. (Underwood); San Bernardino Mts. (Parish); near Pasadena (McClatchie); Twin Oaks, San Diego Co. (Koch).

A. Carolinianus differs from *A. laevis* L., chiefly in greater size of the thallus, in the longer involucres, scarcely expanded, sometimes contracted, at the mouth, and in the (typically) more slender capsules. The species as a whole is perhaps to be looked upon as an aquatic or semi-aquatic analogue of *A. laevis*, from which it is probably not always distinct. It, however, departs so widely from the ordinary conception of *Anthoceros laevis* and is usually so easily recognizable that we think it has a fair claim to specific recognition.

The var. *occidentalis* differs from the *Anthoceros Carolinianus* Michx. of the Southern States in the usually more densely caespitose ascending thallus, sometimes forming, when growing, wide cushions 3–4 cm. in depth, while that of the typical *A. Carolinianus* is commonly prostrate; in the occasionally glandular-thickened margins and lobes; and in the less slender capsule. In the glandular-thickened forms of this variety, involucres which seem abnormally shortened and incrassate (2–2.5 mm. × 1 mm.) are often found intermingled with the longer. Such involucres commonly have scarious mouths.

PLATE 121. ANTHOCEROS CAROLINIANUS OCCIDENTALIS.

1 and 2. Portions of the thallus, natural size.
3–5. Involucres, × 12.
6. Segment of thallus with marginal glandular-thickening, × 6.
7. Transverse section of thallus segment (showing but one half the width), × 25
8. Spores, × 305.
9. Pseudo-elaters, × 225.

Figs. 1–3, 8 and 9 from a specimen collected near Olema, Marin Co. (Mr. W. L. Jepson); 4 and 6, Twin Oaks, San Diego Co. (Mr. F. W. Koch); 5, Howell Mountain, Napa Co. (Prof. W. A. Setchell); 7, Mt. Tamalpais, Marin Co.

4. ANTHOCEROS FUSIFORMIS Aust. Bull. Torr. Bot. Club, 6: 28. 1875.

Thallus in depressed rosettes 6–20 mm. in diameter, or often suberect and caespitose in tufts 5–20 mm. deep, thick and rather rigid, opaque and blackened when dry, undulate-crisped, deeply and irregularly dissected, ecostate, cavernose within, 10–25 cells thick in median parts, becoming rather abruptly 3- or 2-stratose at margin, often with large and abundant glandular-thickenings, more or less lamellate-cristate, lacunose, the lamellae sometimes broad and leaf-like; surface-cells somewhat distinct, subquadrate to oblong-hexagonal, 30–75 μ × 18–40 μ, with large chloroplast, inner cells much broader and longer in axile and basal parts, but often scarcely larger toward the growing apices: monoicous: antheridia in groups of 2–4: involucres often numerous and crowded, but very rarely with the bases united in pairs, subfusiform or narrowly cylindrical, often curved, 2–9 mm. × .35–1.2 mm., smooth, furrowed, or rarely lamellate, mouth repand or scarious and erose-lacerate: capsule dusky brown to black, 2–9 cm. (mostly 3–6 cm.) × .25–.5 mm., rather long-pedicellate, valves commonly a little twisted on drying, stomata abundant, the guard-cells nearly colorless; spores dark-brown or black, 45–63 μ in maximum diameter, angular, the convex face with very numerous (125–225) spines or papillae less than 3 μ in length, plane faces granulose-papillate or sinuate-foveolate; pseudo-elaters fuscous, 60–250 μ × 8–14 μ, of 1–4 cells, geniculate and variously contorted, sometimes branched.

Exsicc. Hep. Am. 163.

On moist banks. Common on the Pacific Coast from southern California to British Columbia.

Mill Valley (15, 1208), Ross Valley (1207); Ukiah (774), Pieta (808), near Mendocino (616 in part, 630b, 664); Eureka (935); Douglas City, Trinity Co. (1137); Palo Alto (Campbell); Felton, Santa Cruz Co. (Farlow); bank of Kaweah River, Tulare Co. (Coville and Funston, Death Valley Expedition, no. 1294—a specimen with unusually abundant and foliaceous lamellae); Devil's Cañon, San Bernardino Mountains (Parish, 2305), near Rochester (Parish); Pasadena (McClatchie); San Diego (Orcutt).

Anthoceros fusiformis is a close ally of *A. punctatus* L., differing in the larger, thicker, more dissected, and usually more lamel-

late-cristate thallus, the rarely geminate, often longer involucres, the longer capsules, the rather larger, more minutely and thickly echinulate or papillate spores, and in the logner, narrower elaters. In the southern part of California it makes its nearest approach to *A. punctatus*, but may be distinguished from that species after a little experience by the characters of the spores and elaters. The involucres in the Californian plants are rarely more than 5 mm. long. *A. fusiformis* ripens its spores in California in April and May, at which time the thallus has commonly become shriveled and inconspicuous.

Following Austin's original description of *Anthoceros fusiformis* three specimens are cited, as follows: "Observation [Observatory] Inlet, Columbia, Dr. Scouler in herb. Torrey; also in herb. Taylor. California, Bolander. Oregon, E. Hall." What appear to be these three originals are preserved in herb. Pearson. Hall's specimen is marked "R. Mts., Hall," but this manner of giving the habitat of Hall's Oregon Hepaticae is observed elsewhere in the Austin collection.

PLATE 122. ANTHOCEROS FUSIFORMIS.

1. Plant, natural size.
2. Portion of thallus, × 23
3. Anterior margin of thallus-segment in vertical section, × 53.
4 and 5. Dorsal lamellae in vertical section, × 53.
6. Nearly median longitudinal section of thallus-segment, × 53.
7–9. Involucres, × 12.
10. Vertical longitudinal section near thallus-apex, showing antheridia and archegonia, × 53.
11. Spores, × 305.
12. Pseudo-elaters, × 305.

Figs. 1 and 9 drawn from no. 1207 (Ross Valley, Marin Co.); 2, from no. 1208 (Mill Valley, Feb. 22, 1896); 3-6, and 10, from microtome sections of material collected in Ross Valley; 7, from no. 808 (Pieta, Mendocino Co.); 8, from a specimen collected in California by Dr. Bolander; 11 and 12, from no. 15 (Mill Valley).

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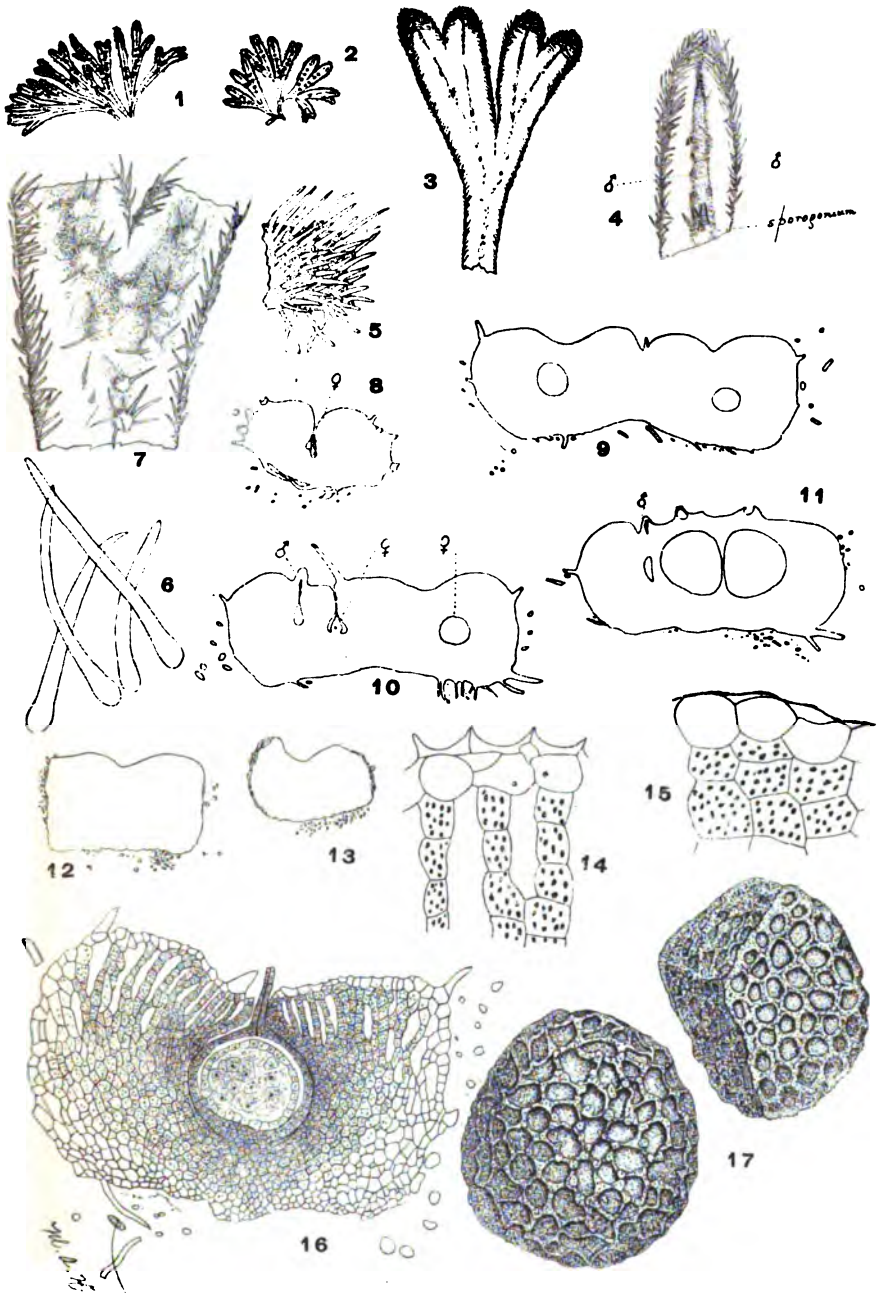

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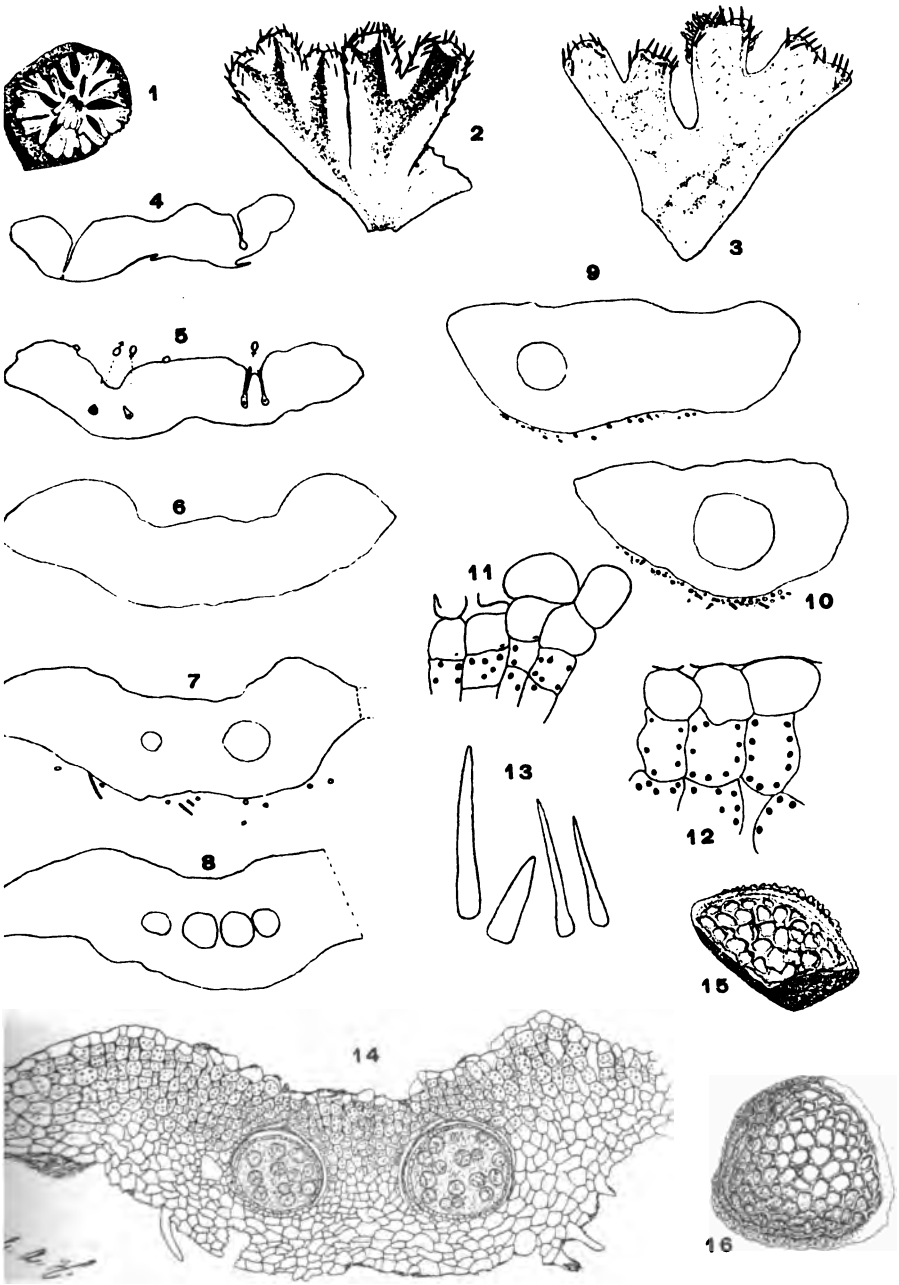

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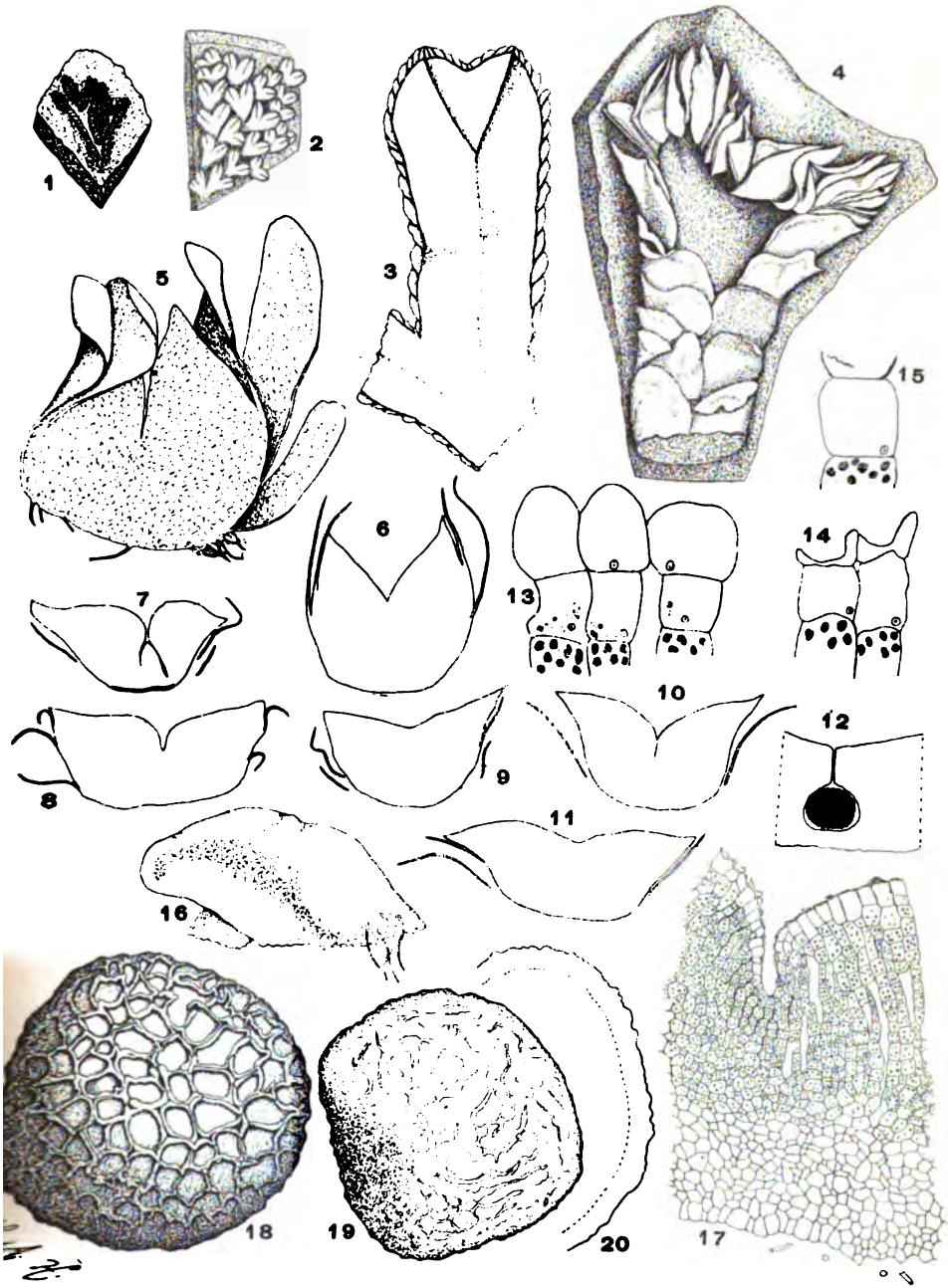

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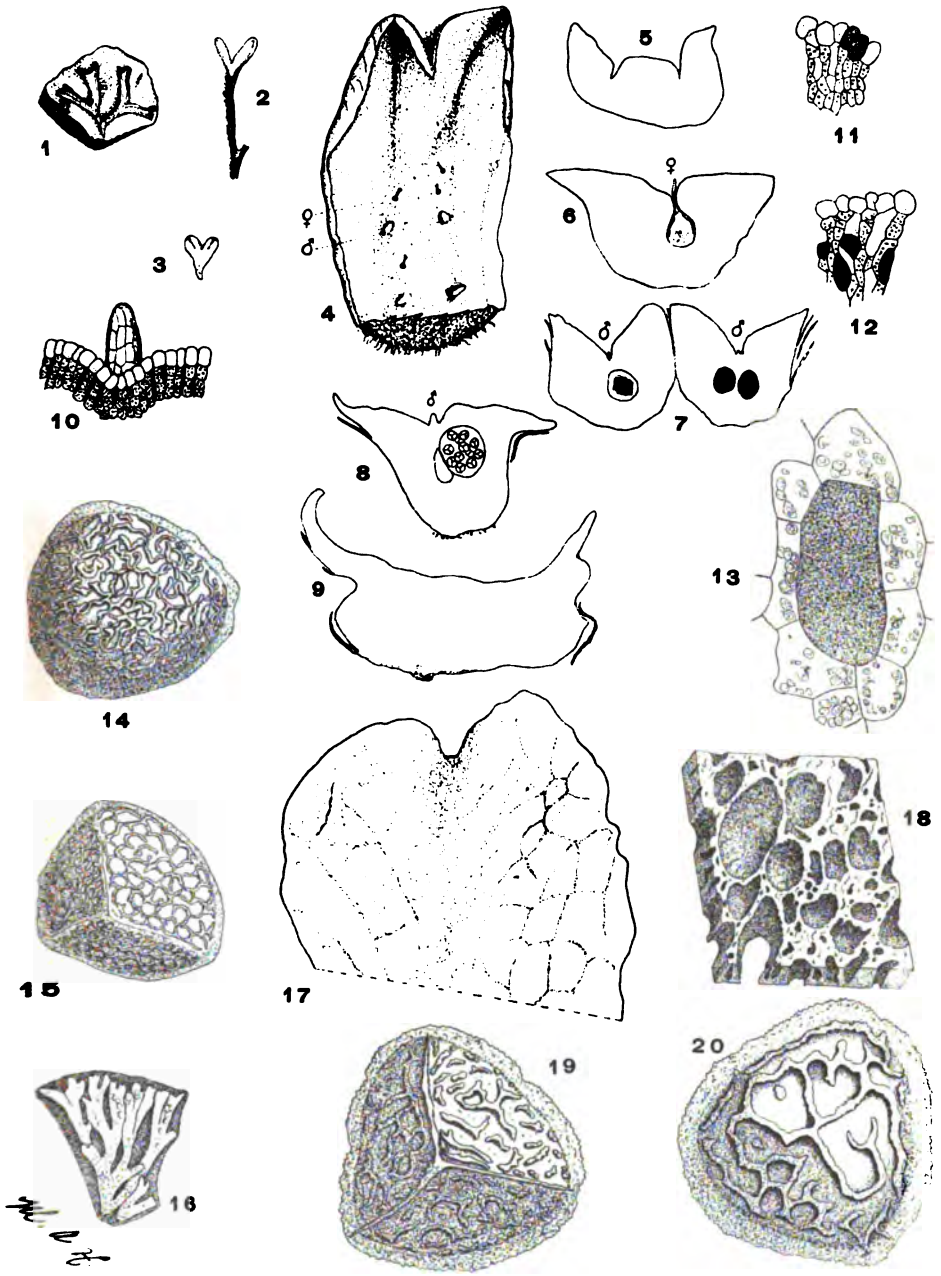

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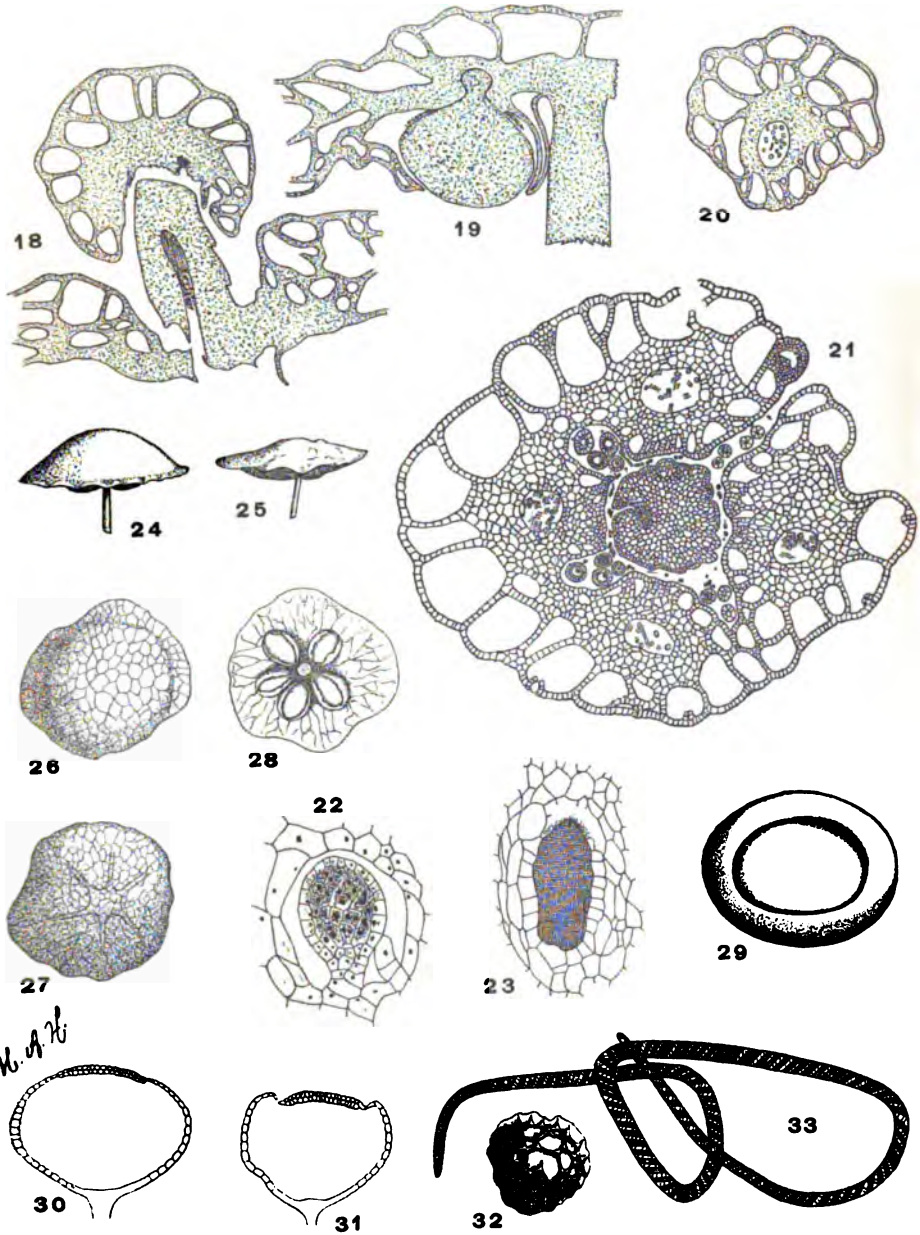
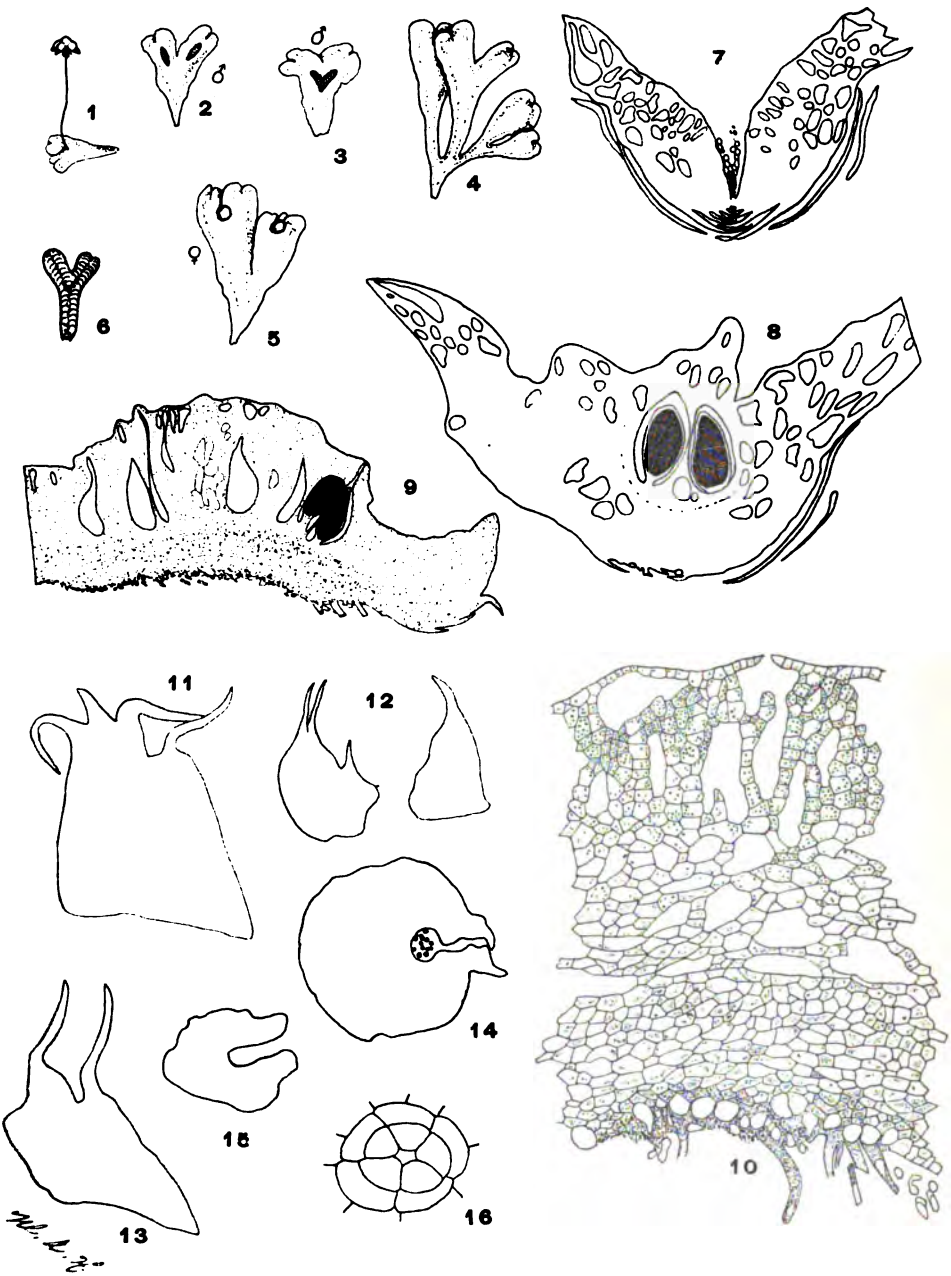
16-20. RICCIA CATALINAE Underw.



CRPTOMITRIUM TENERUM (Hook.) Aust.



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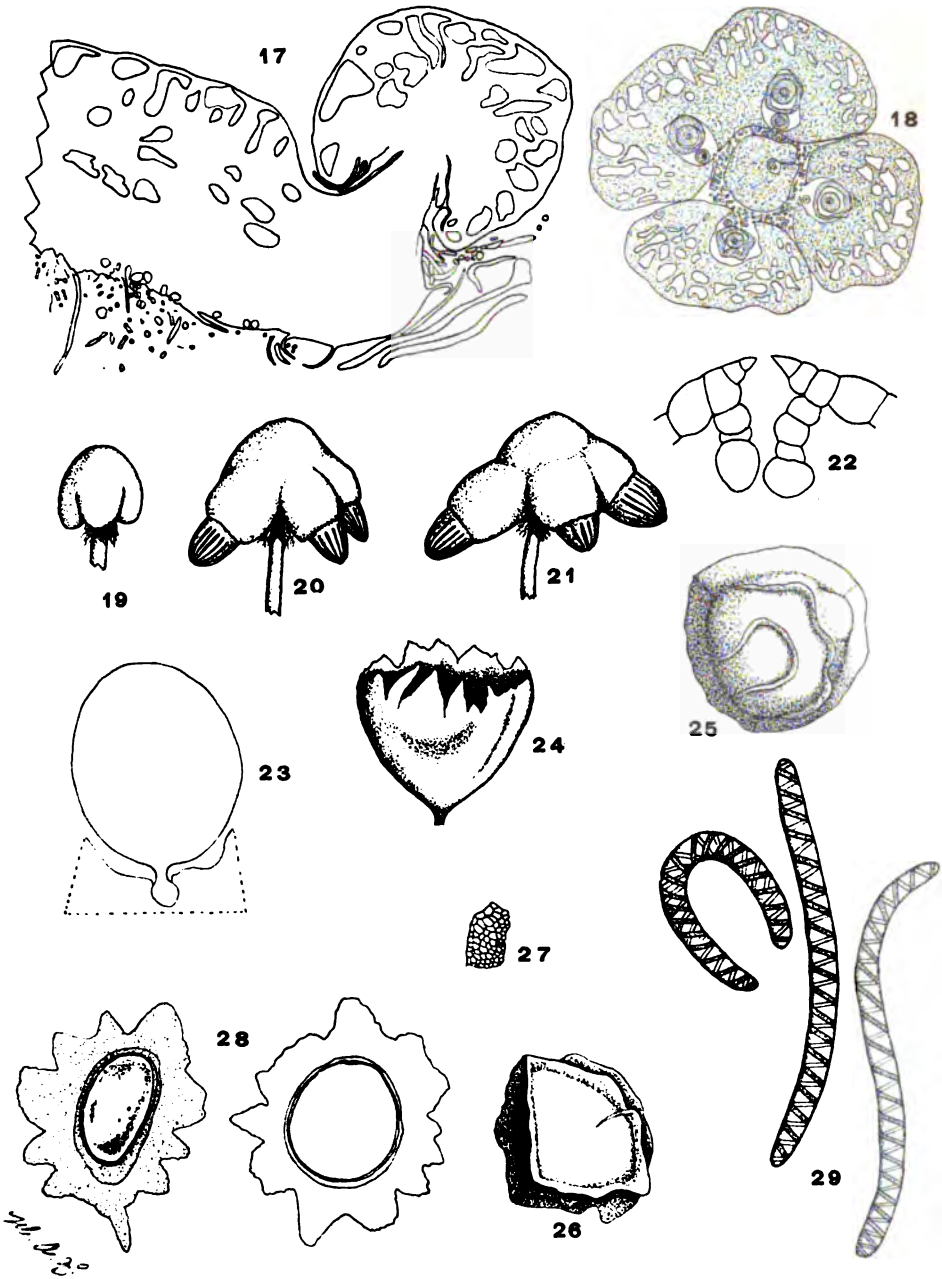

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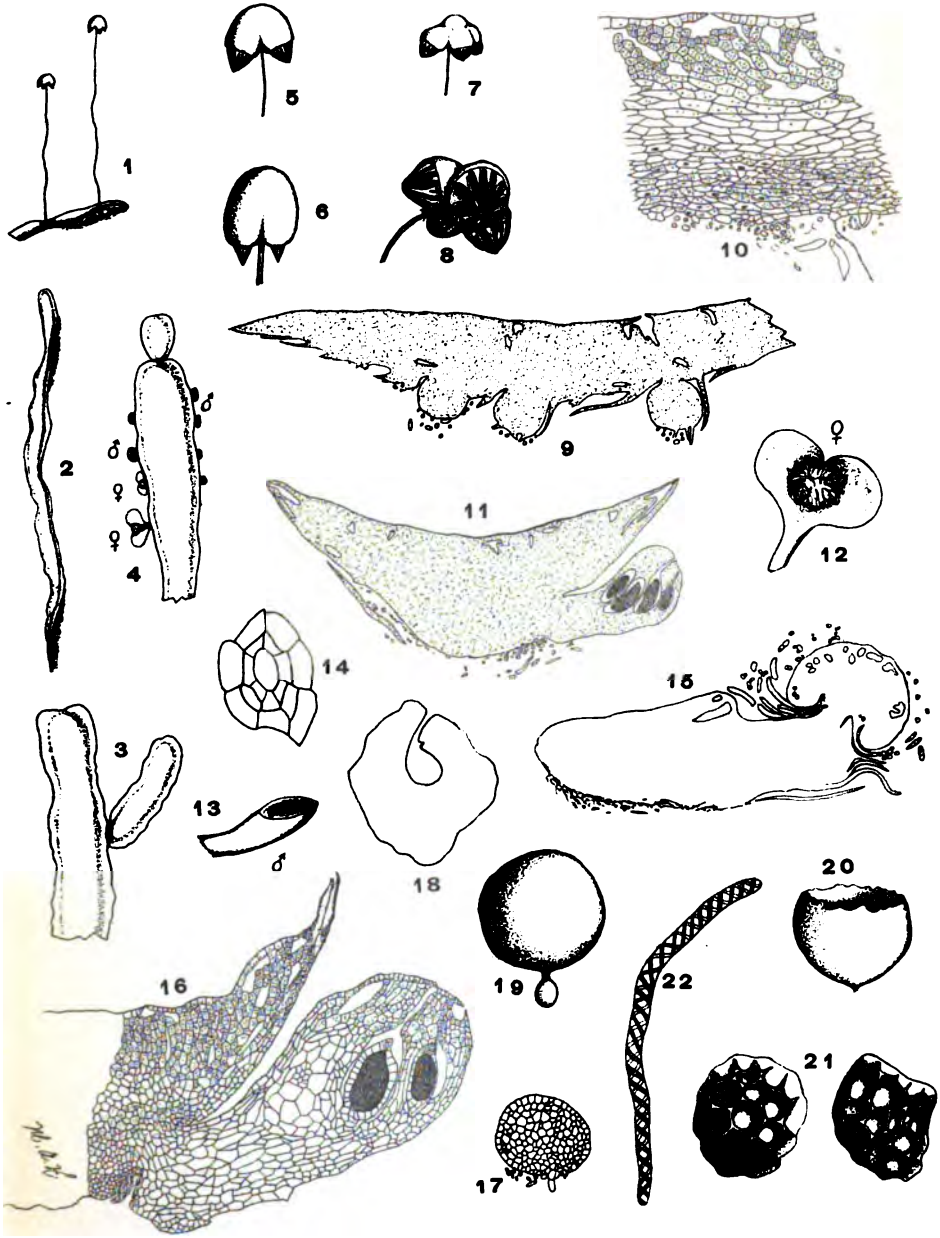

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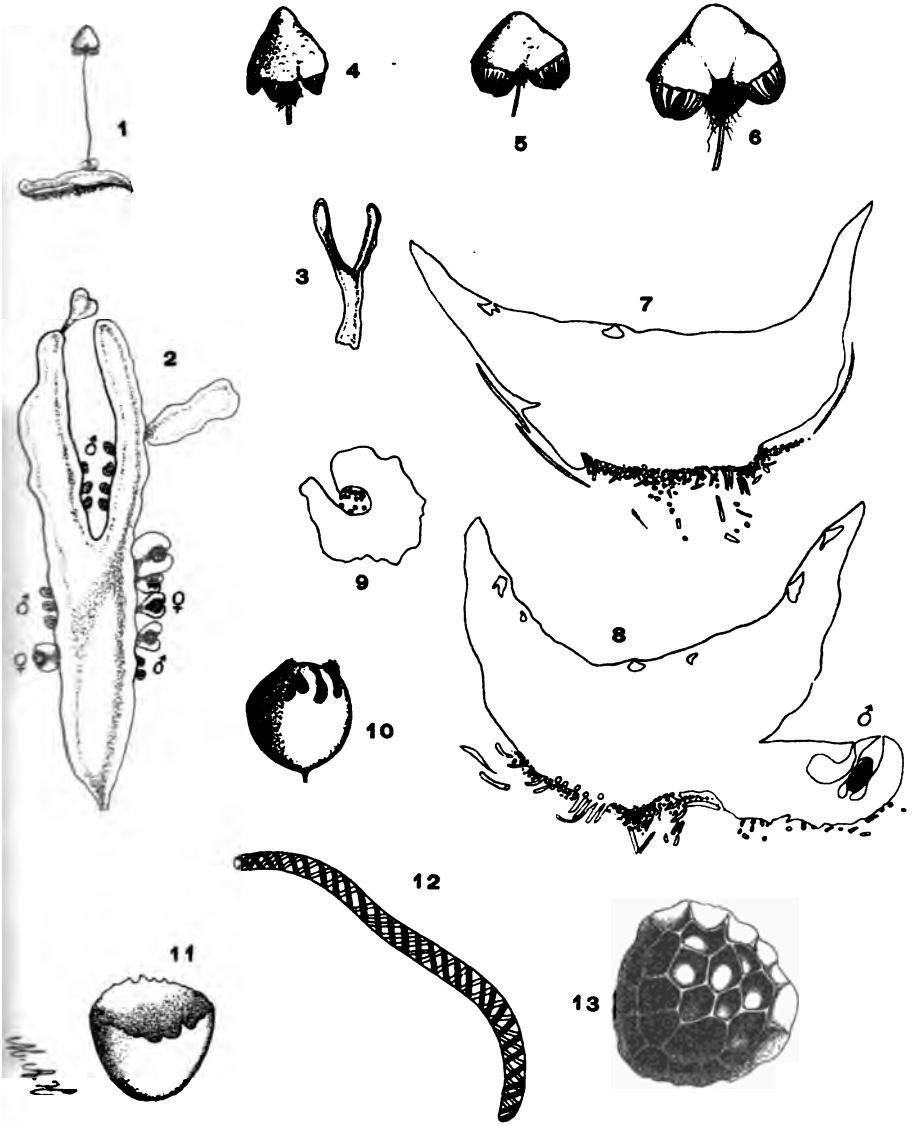

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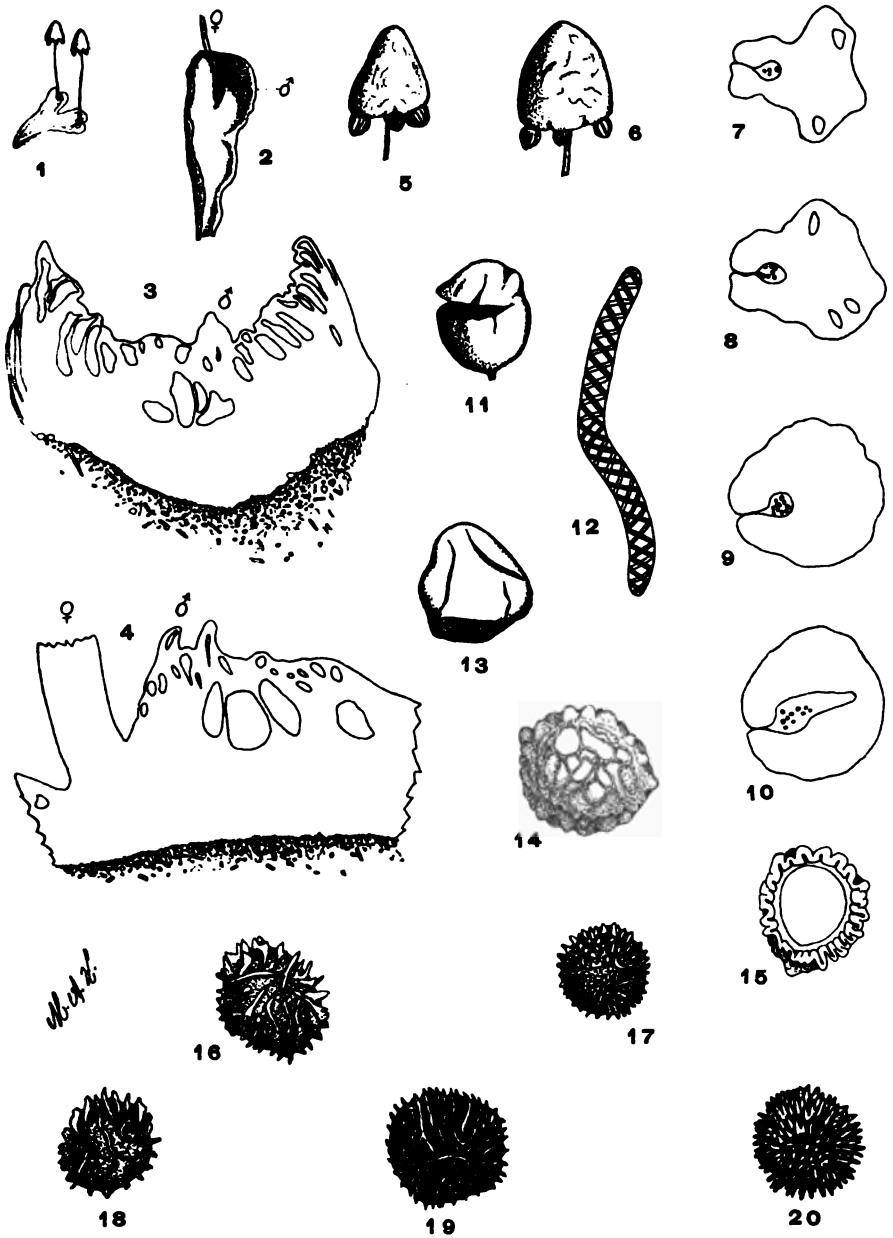

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16-20. FOSSOMBRONIA LONGISETA Aust.

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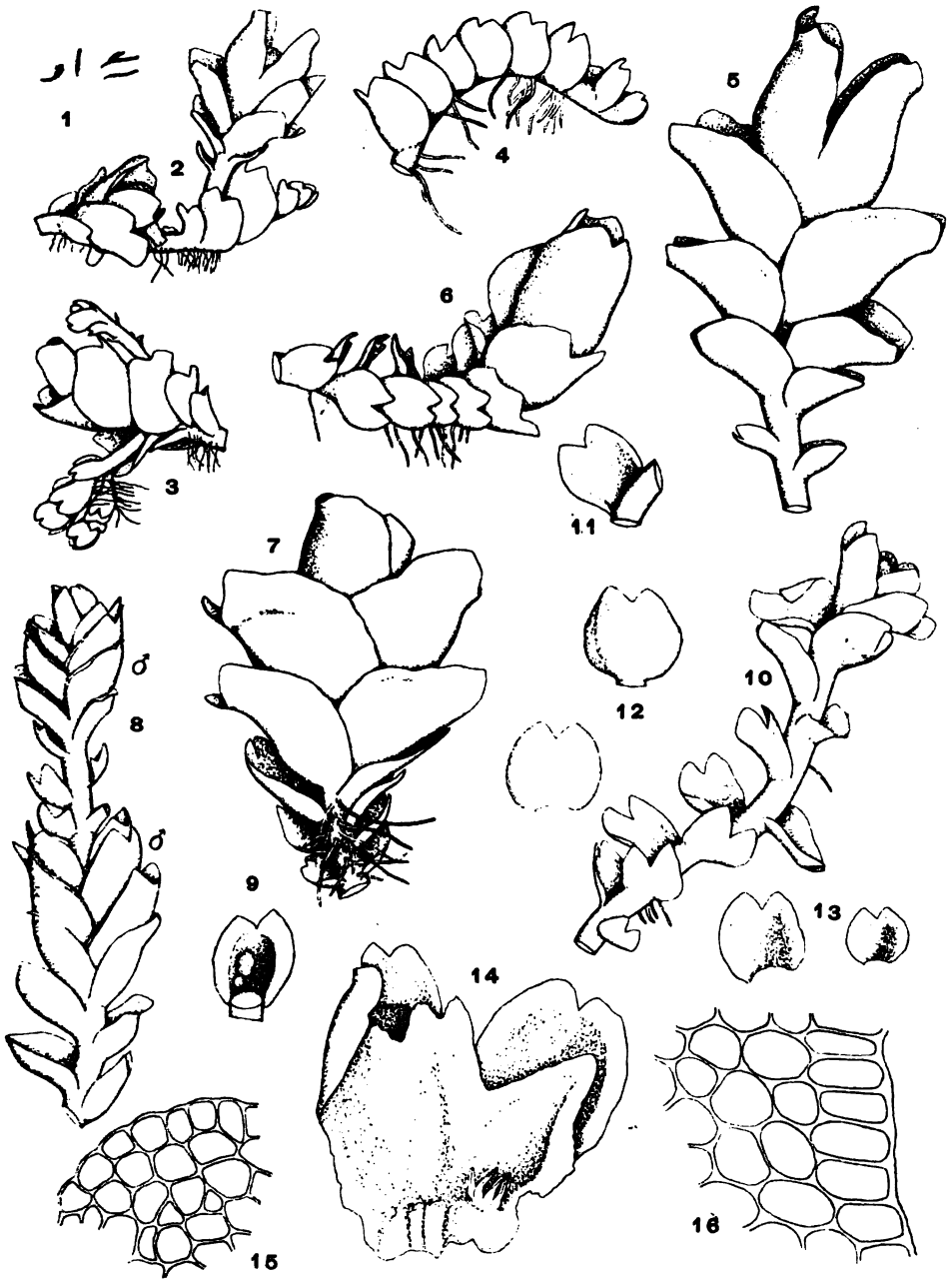
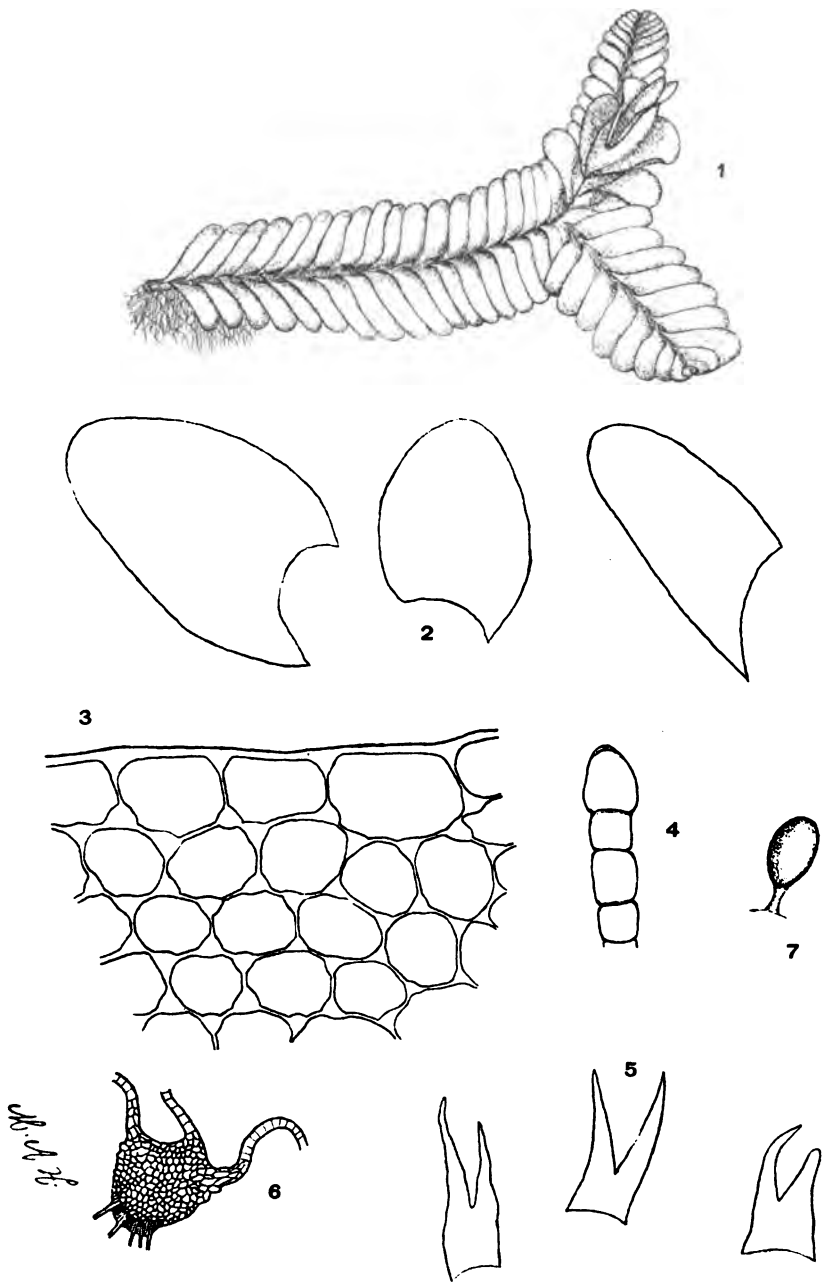
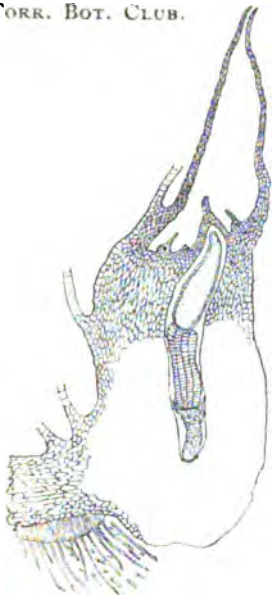


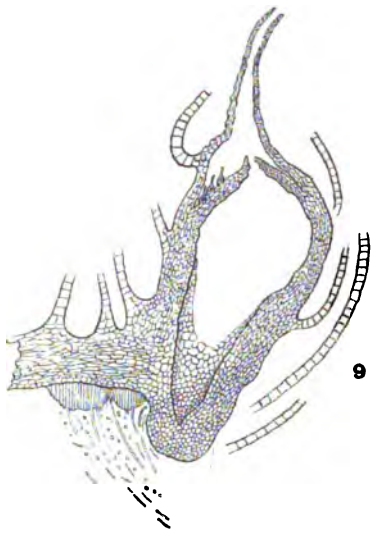
MARSUPELLA BOLANDERI (Aust.) Underw.

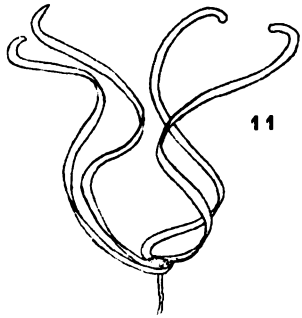
THE HELIOTYPE PRINTING CO., BOSTON

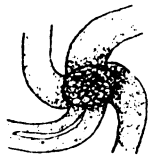


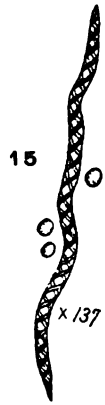
GYROTHYRA UNDERWOODIANA M. A. Howe.



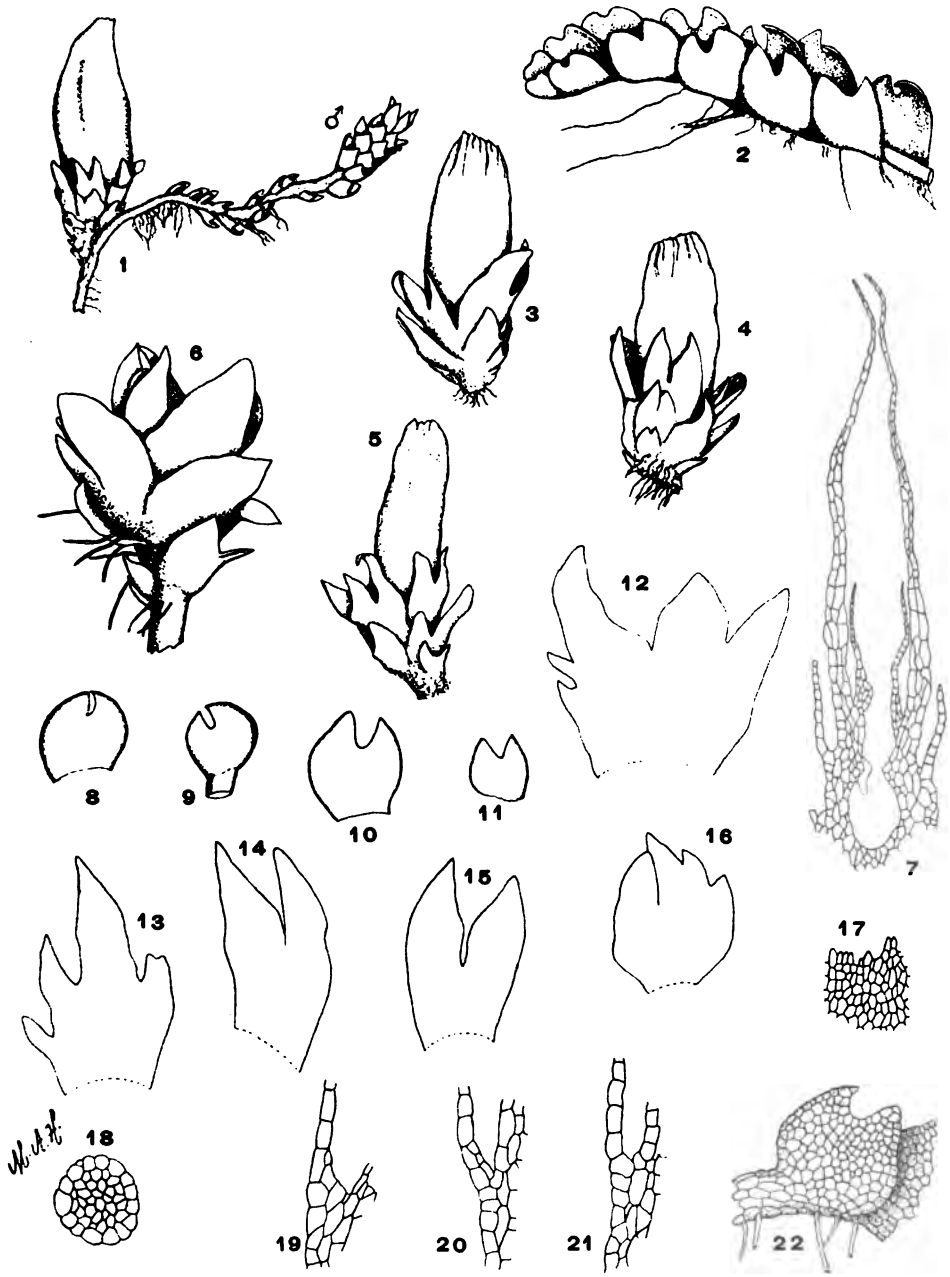




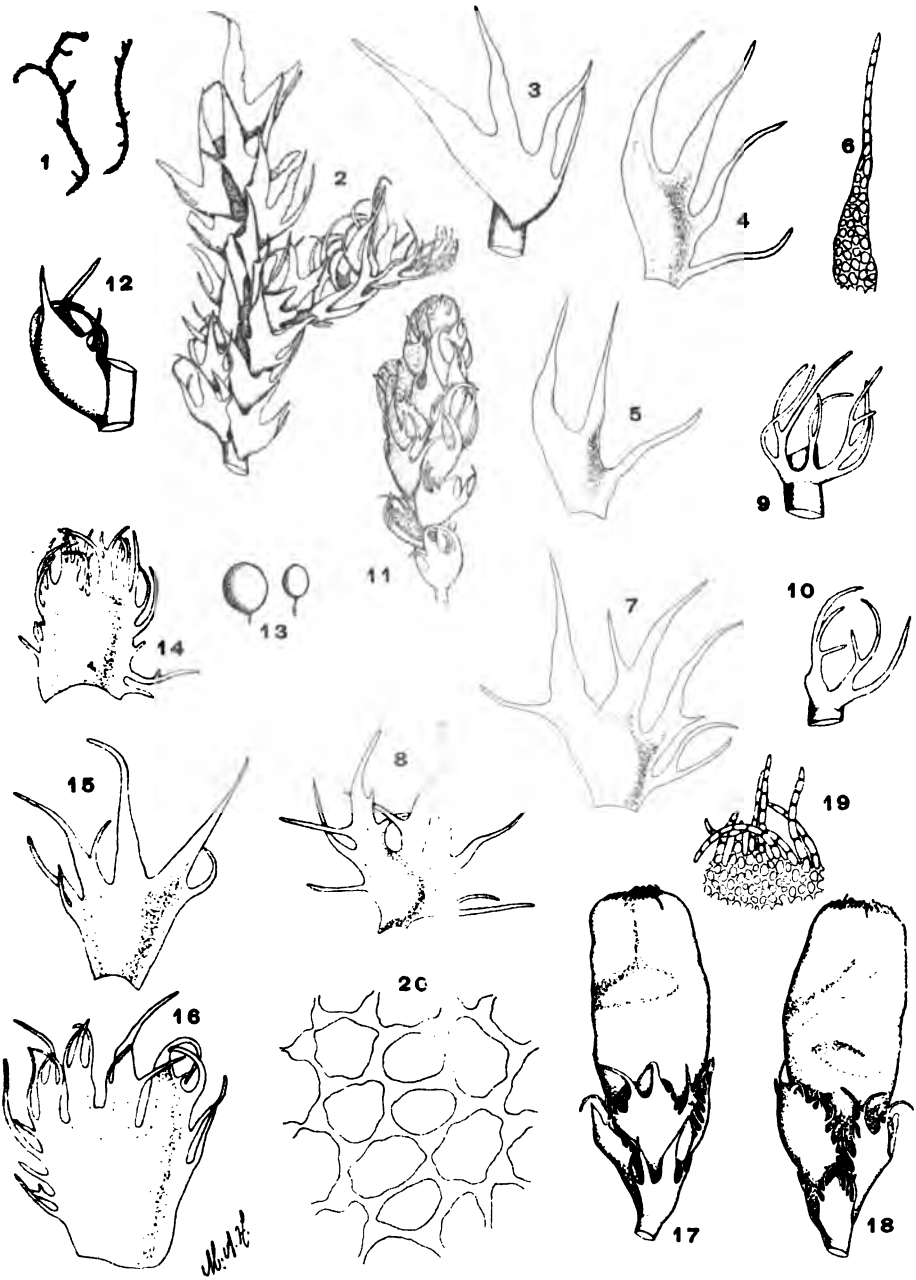




GYROTHYRA UNDERWOODIANA M. A. Howe.

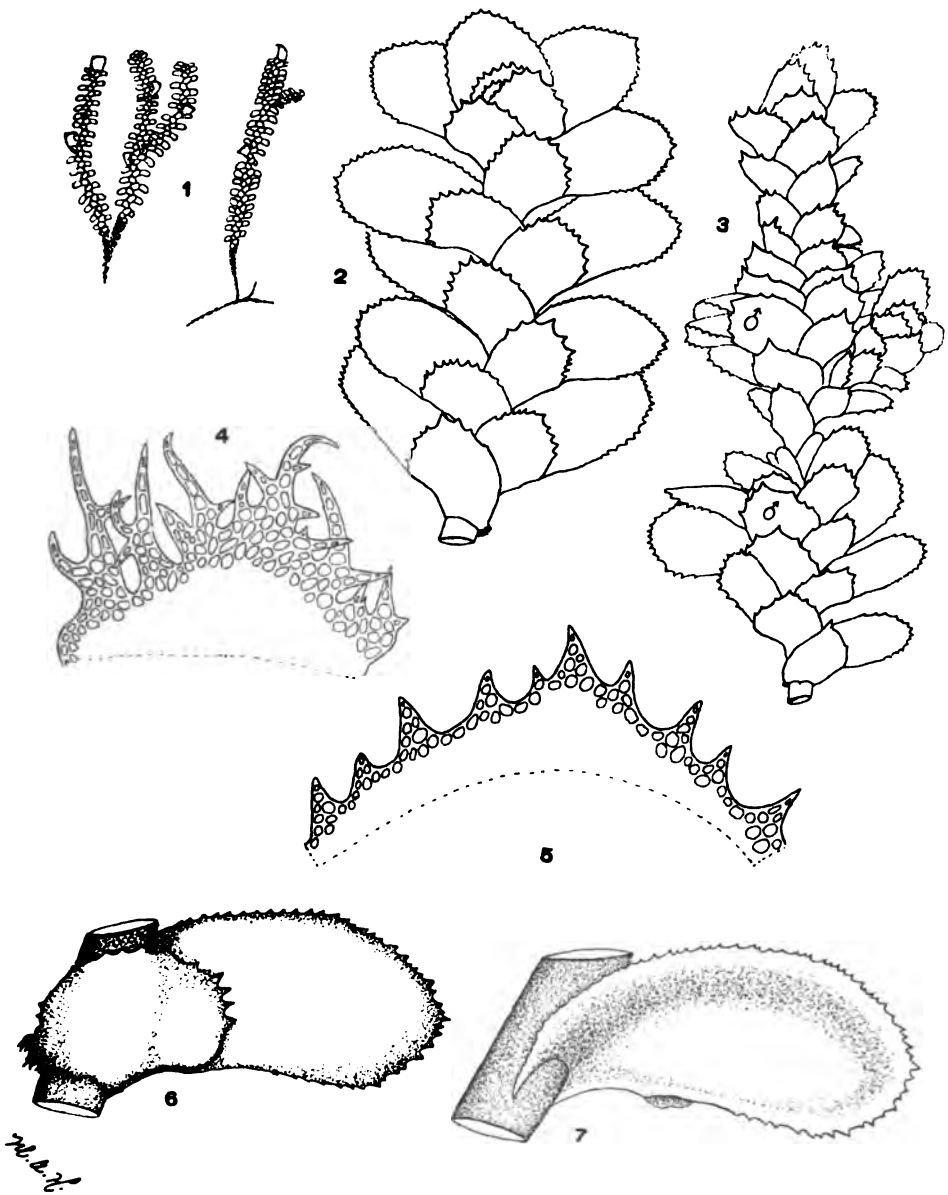


CEPHALOZIA PLENICEPS Aust.



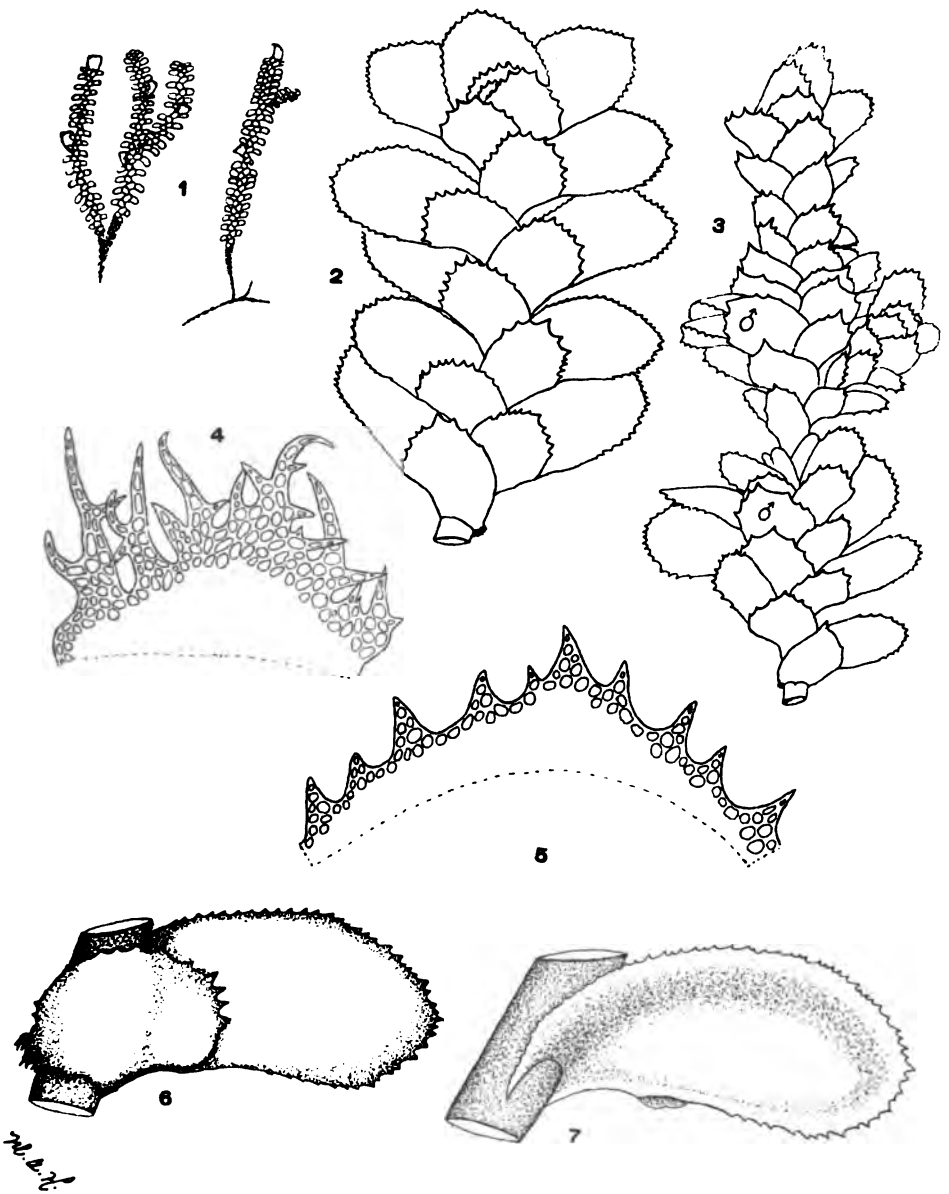
PTILIDIUM CALIFORNICUM (Aust.) Underw. and Cook.

THE HELIOTYPE PRINTING CO., BOSTON



SCAPANIA BOLANDERI Aust.

THE HELIOTYPE PRINTING CO., BOSTON.



SCAPANIA BOLANDERI Aust.

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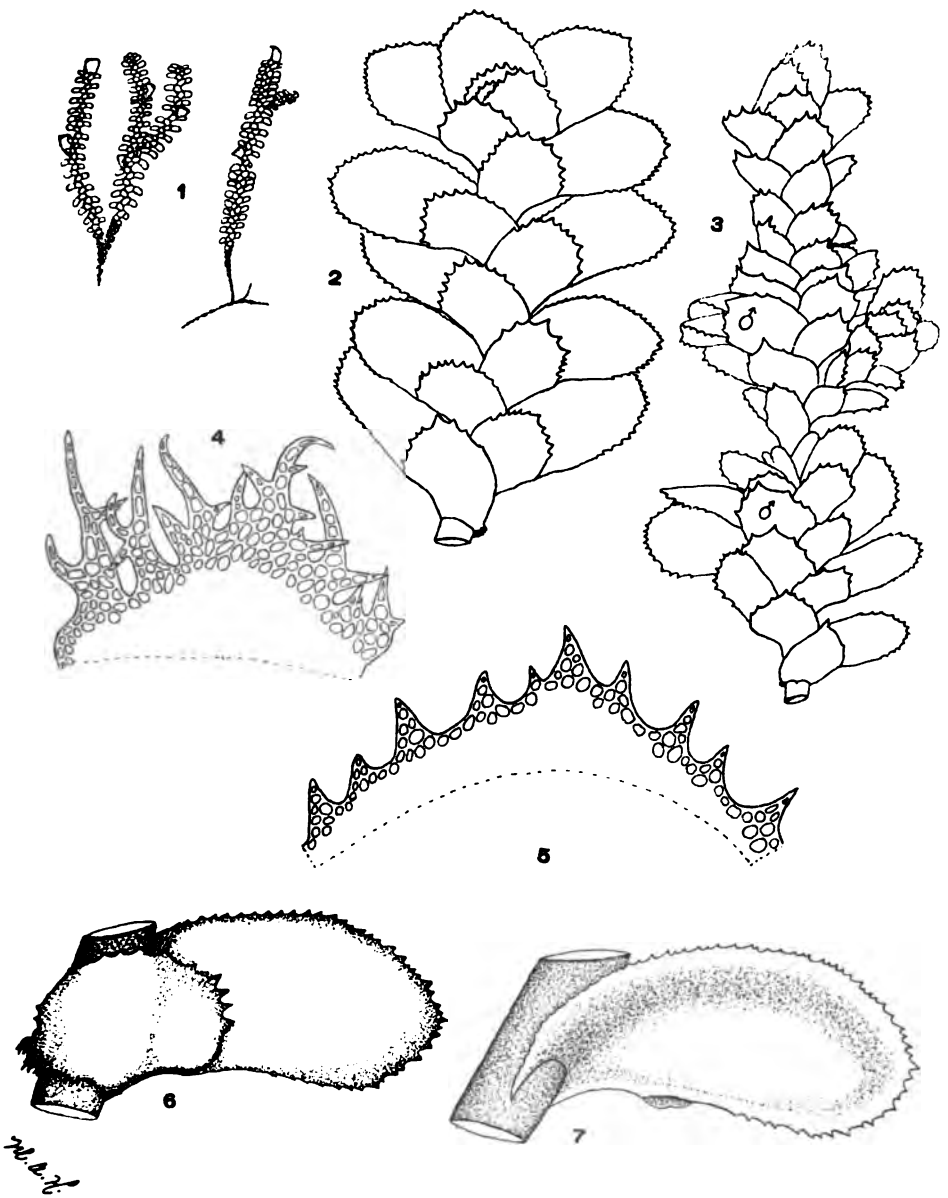

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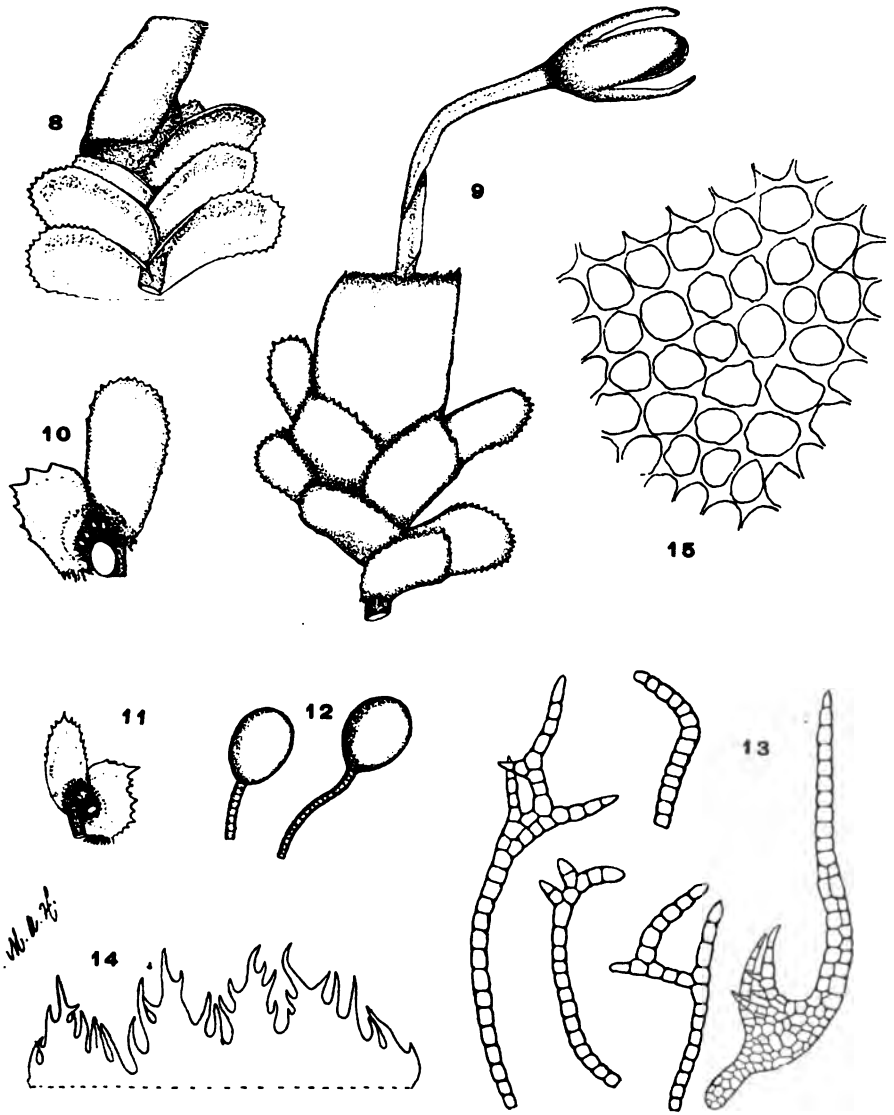
THE HELIOTYPE PRINTING CO., BOSTON



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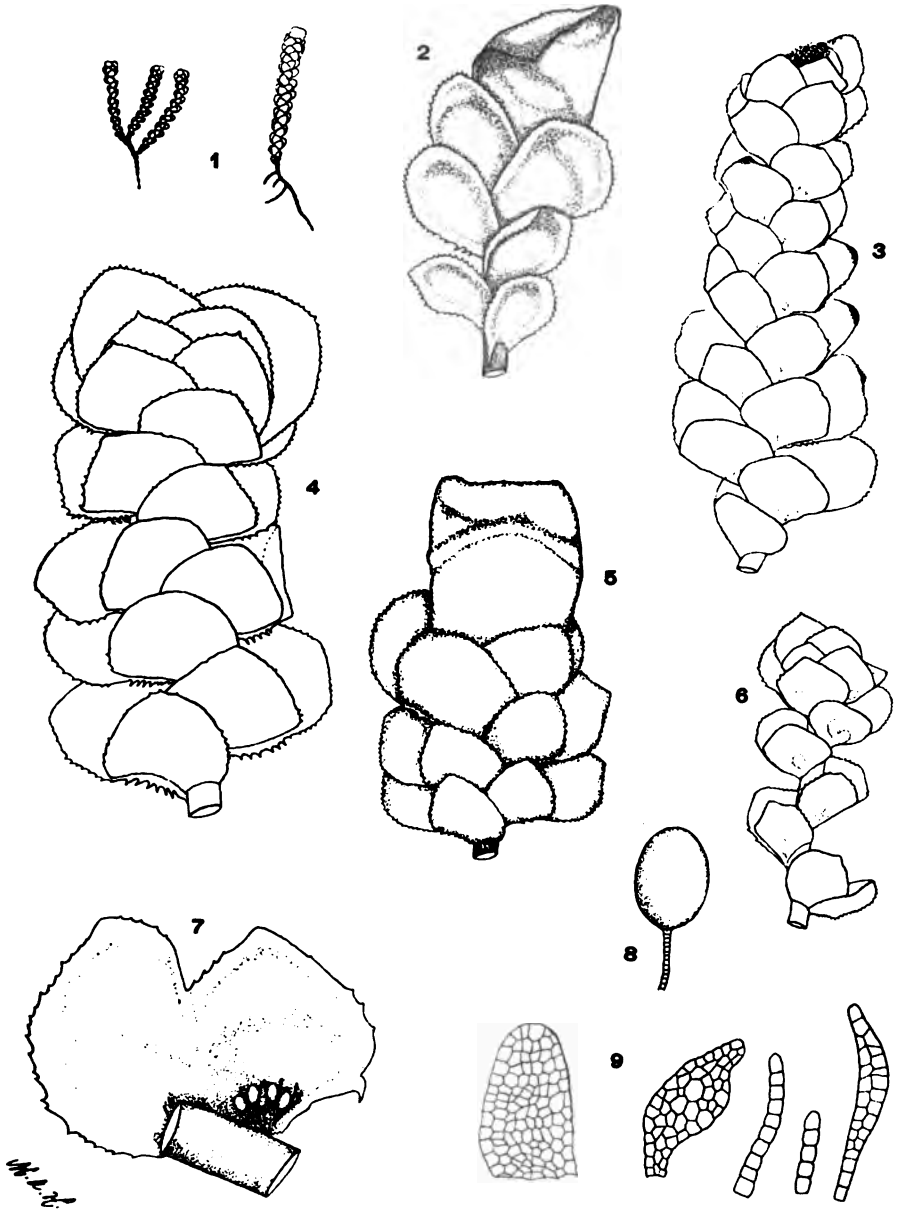
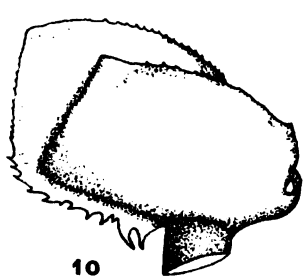
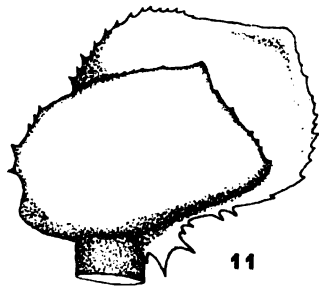
THE HELIOTYPE PRINTING CO., BOSTON

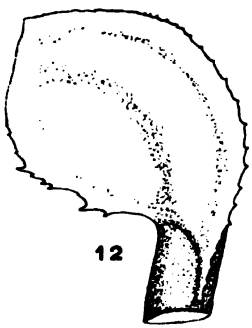


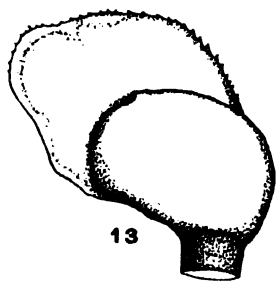
SCAPANIA OAKESII Aust.

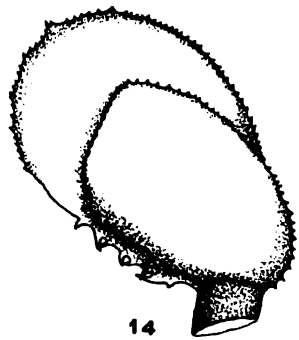
THE HELIOTYPE PRINTING CO., BOSTON

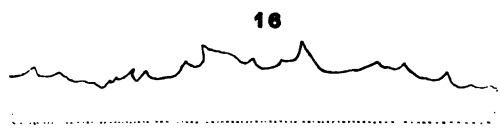


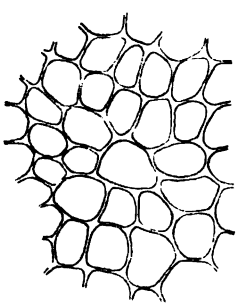


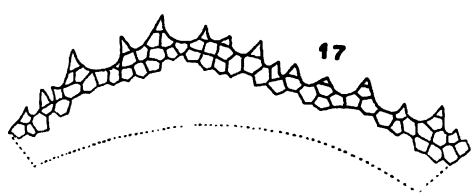






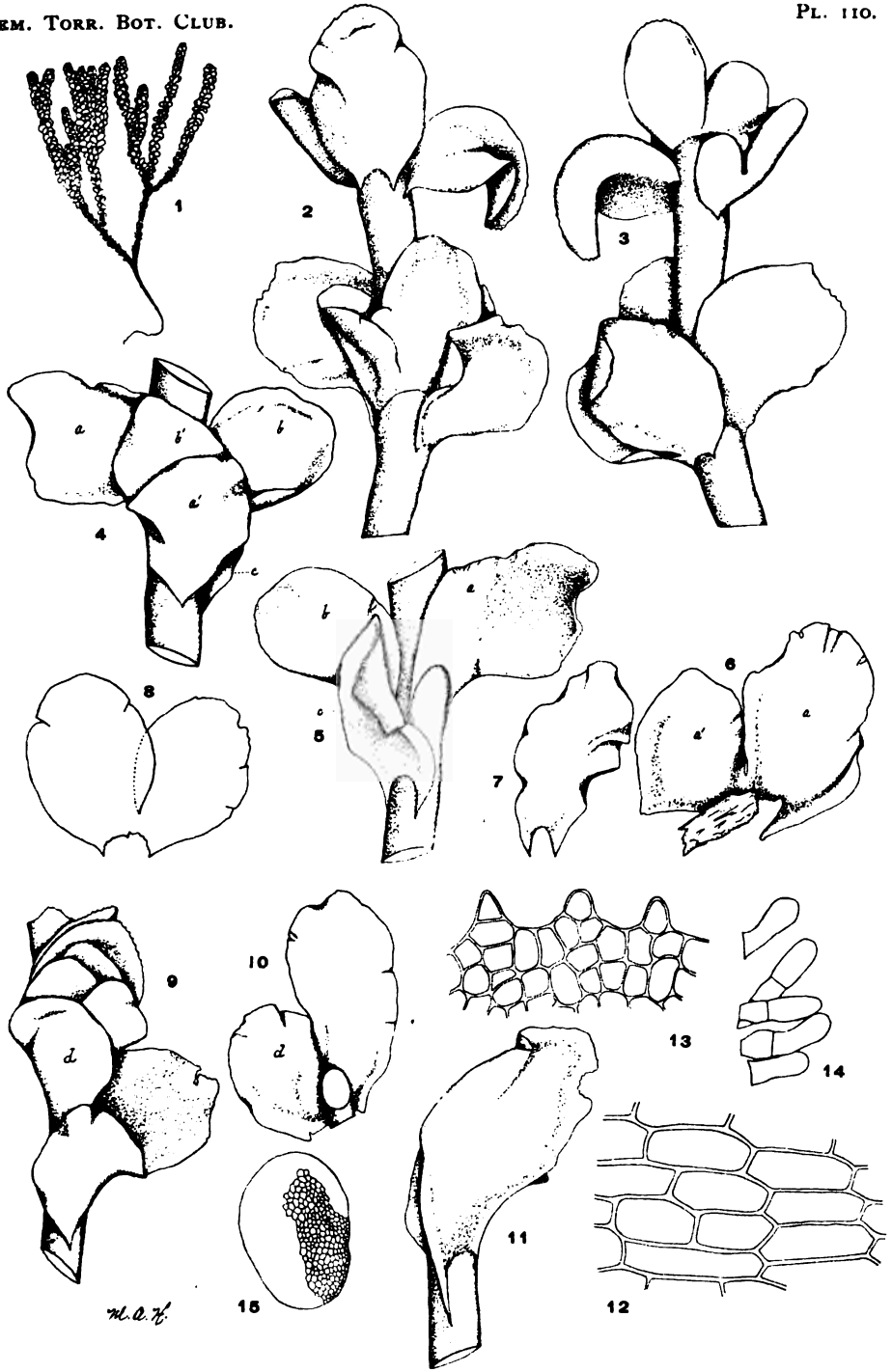






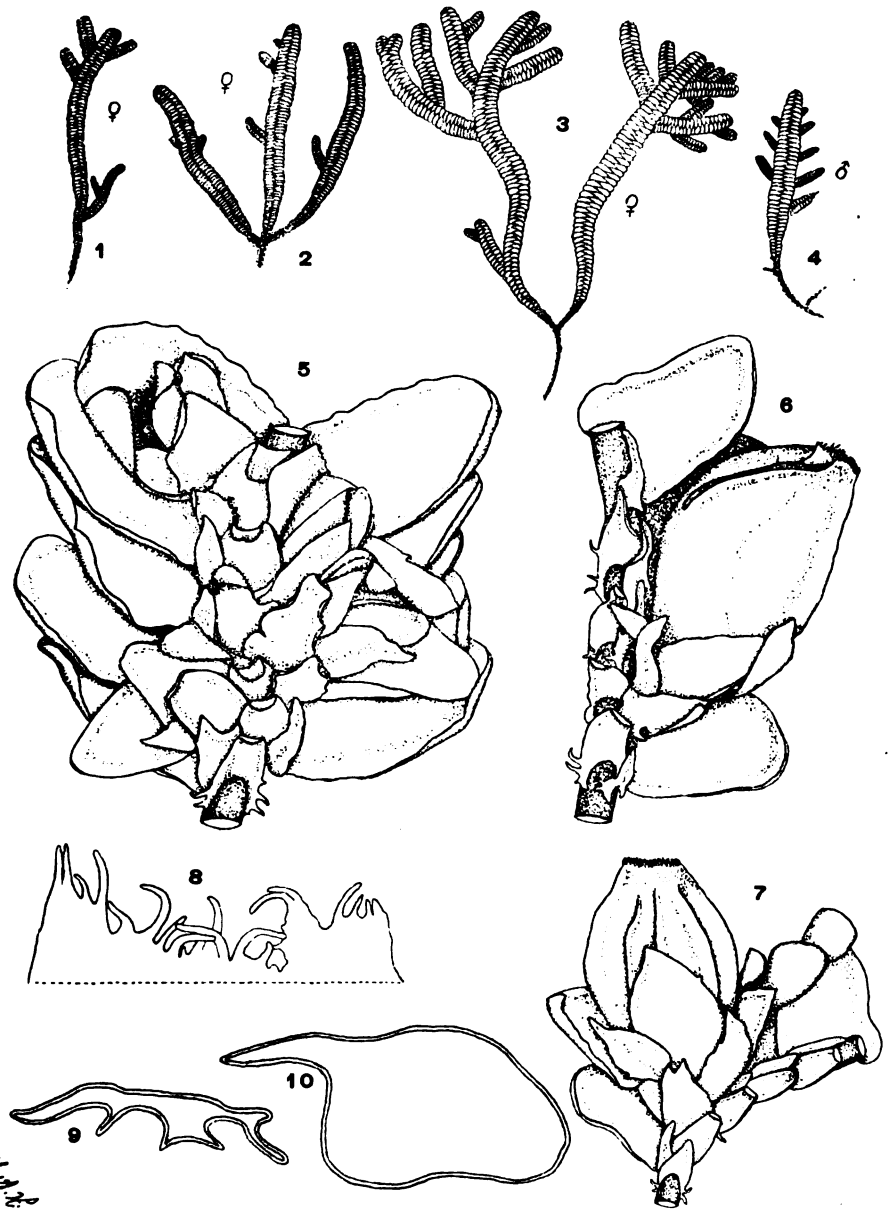
SCAPANIA OAKESII Aust.

THE HELIOTYPE PRINTING CO., BOSTON



SCAPANIA HETEROPHYLLA M. A. Howe.

THE HELIOTYPE PRINTING CO., BOSTON



PORELLA BOLANDERI (Aust.) Pearson.

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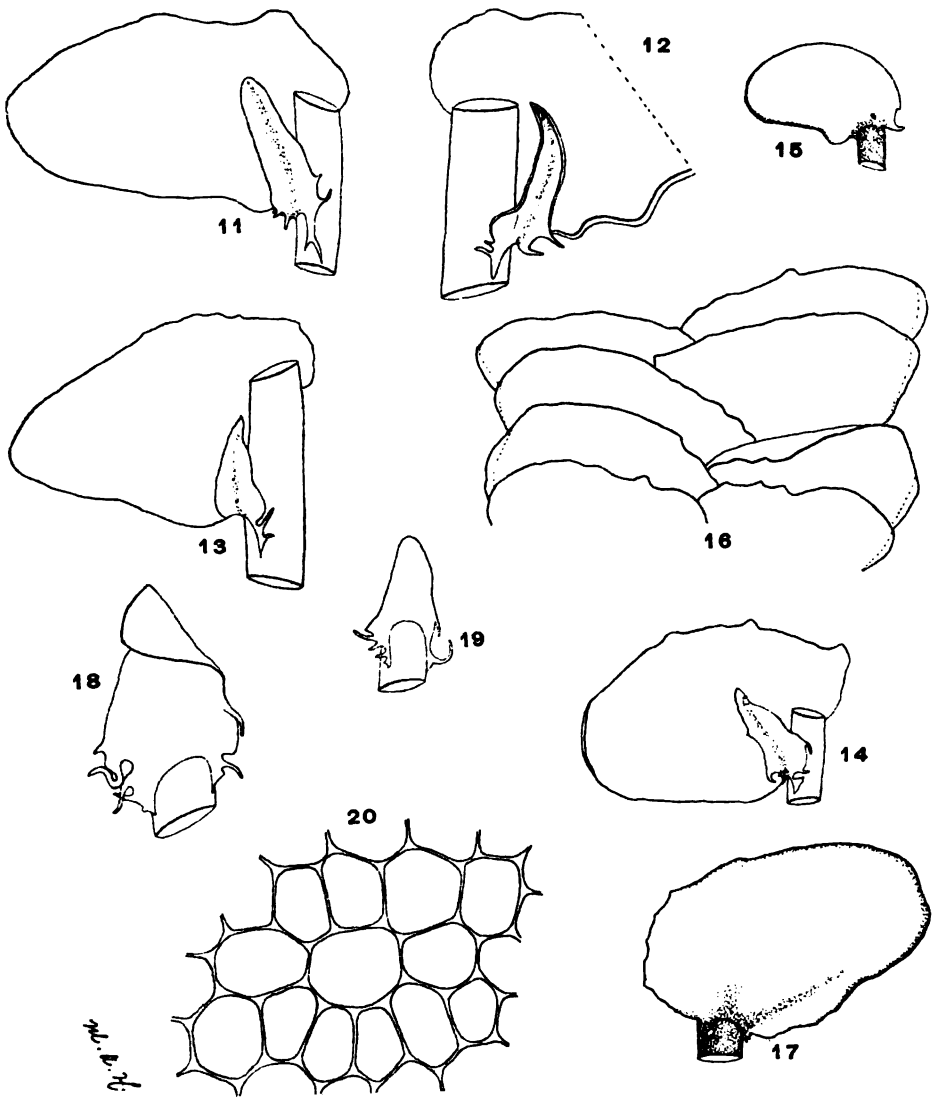

PORELLA BOLANDERI (Aust.) Pearson.

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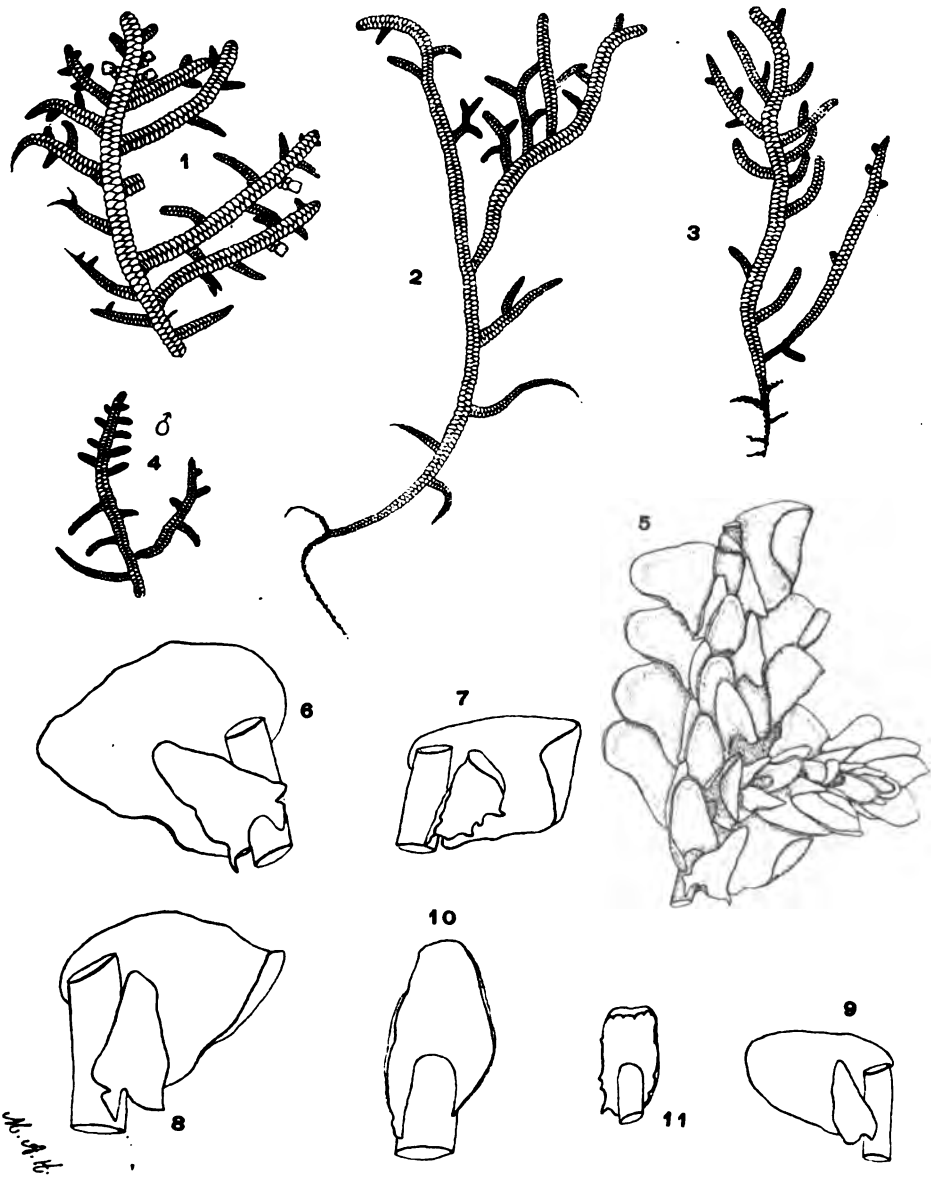

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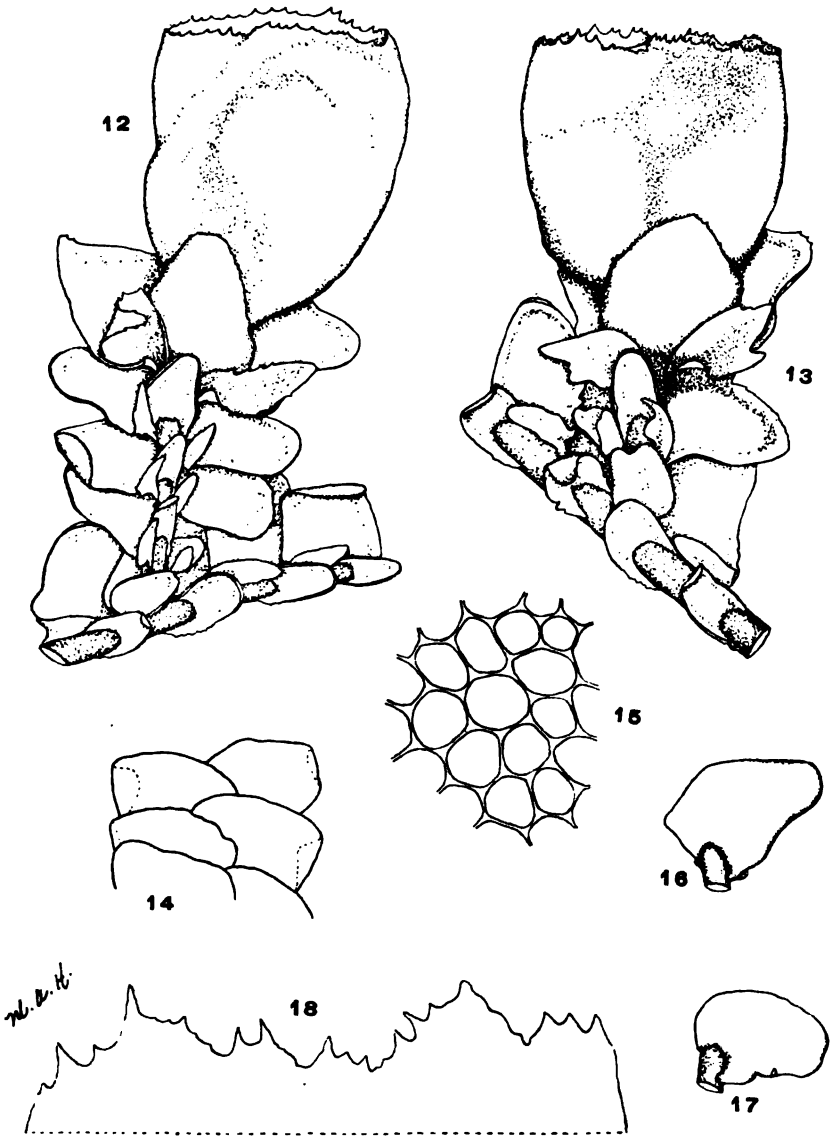

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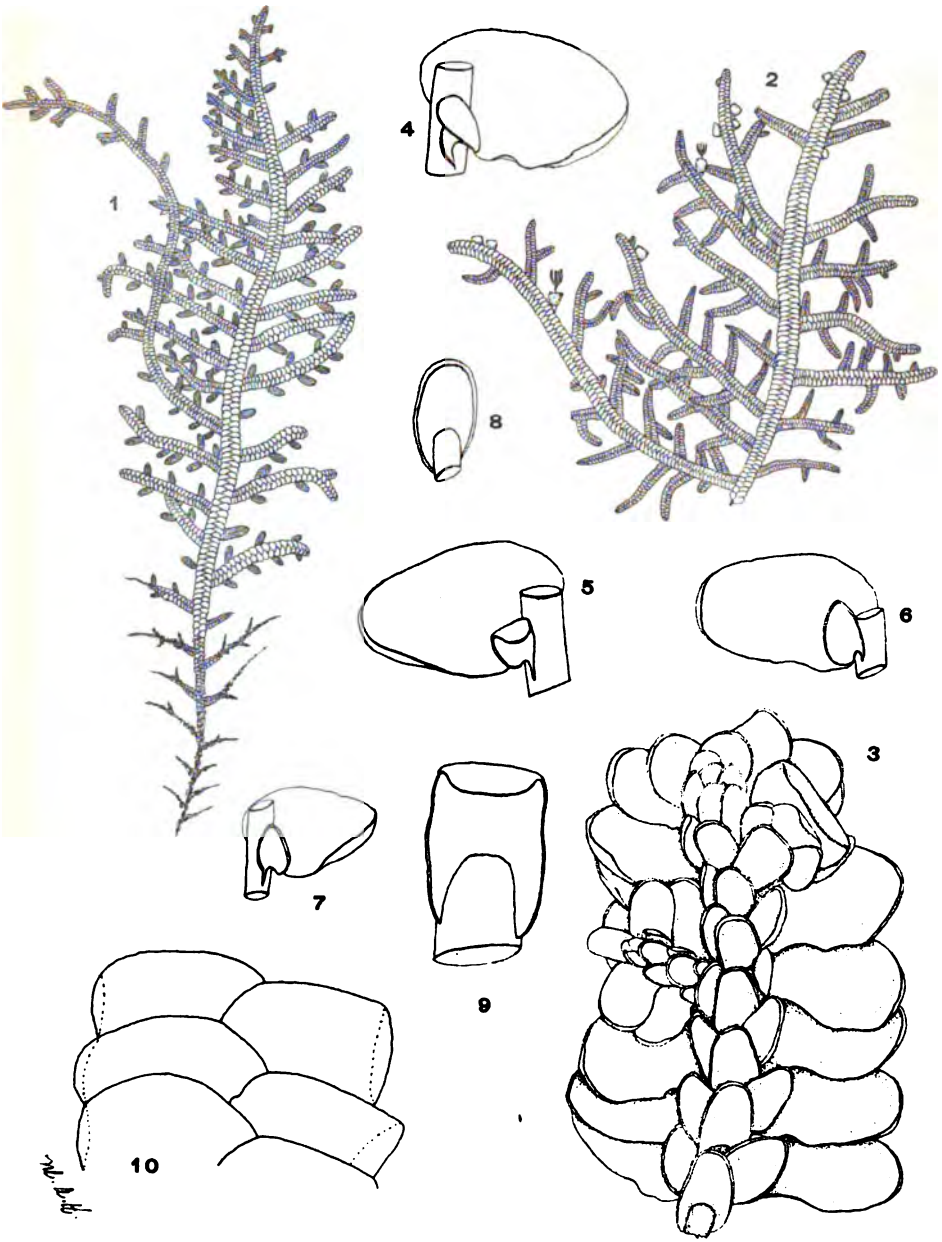

PORELLA NAVICULARIS (Lehm. and Lindenb.) Lindb.

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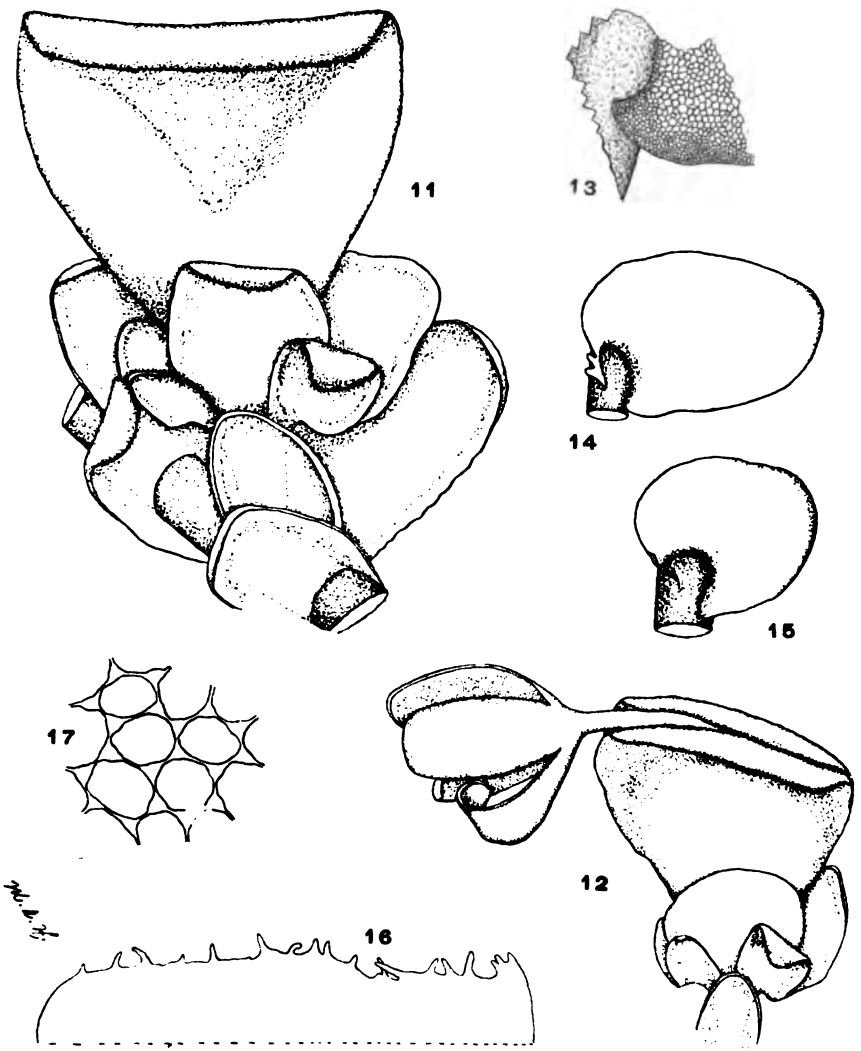
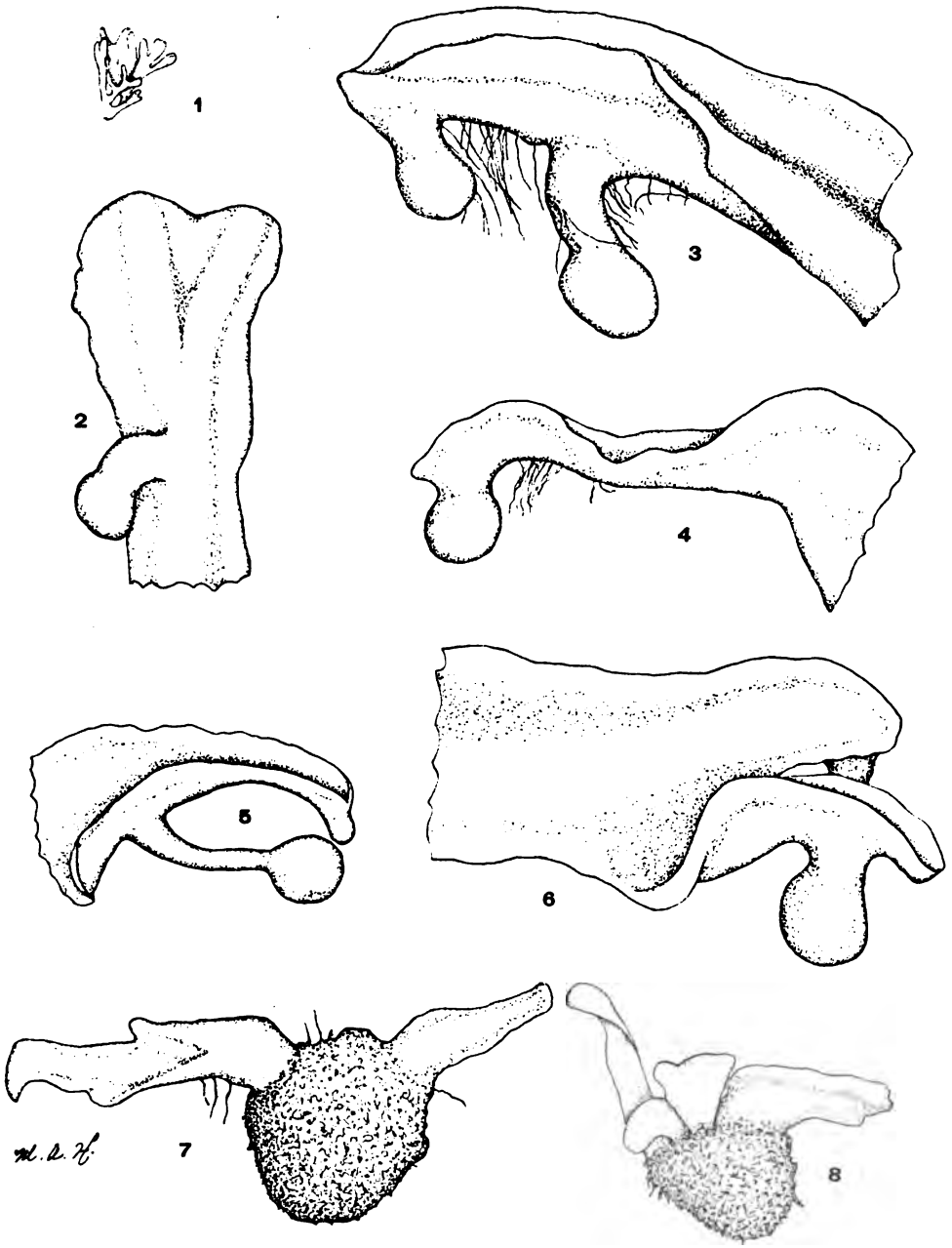


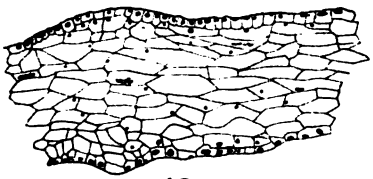
PORELLA NAVICULARIS (Lehm. and Lindenb.) Lindb.

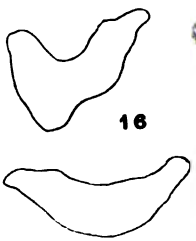
THE HELIOTYPE PRINTING CO., BOSTON

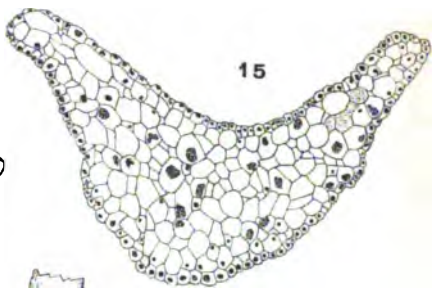


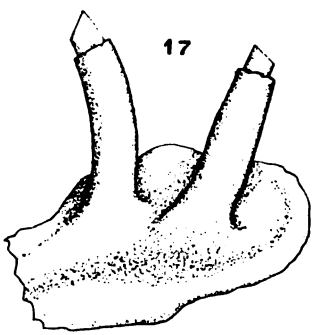
ANTHOCEROS PHYMATODES M. A. Howe.

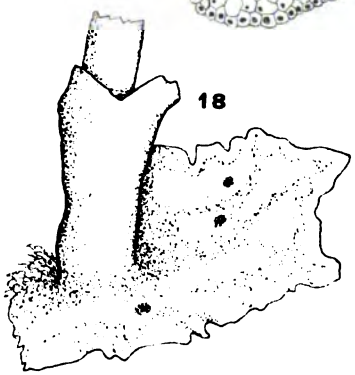
THE HELIOTYPE PRINTING CO., BOSTON







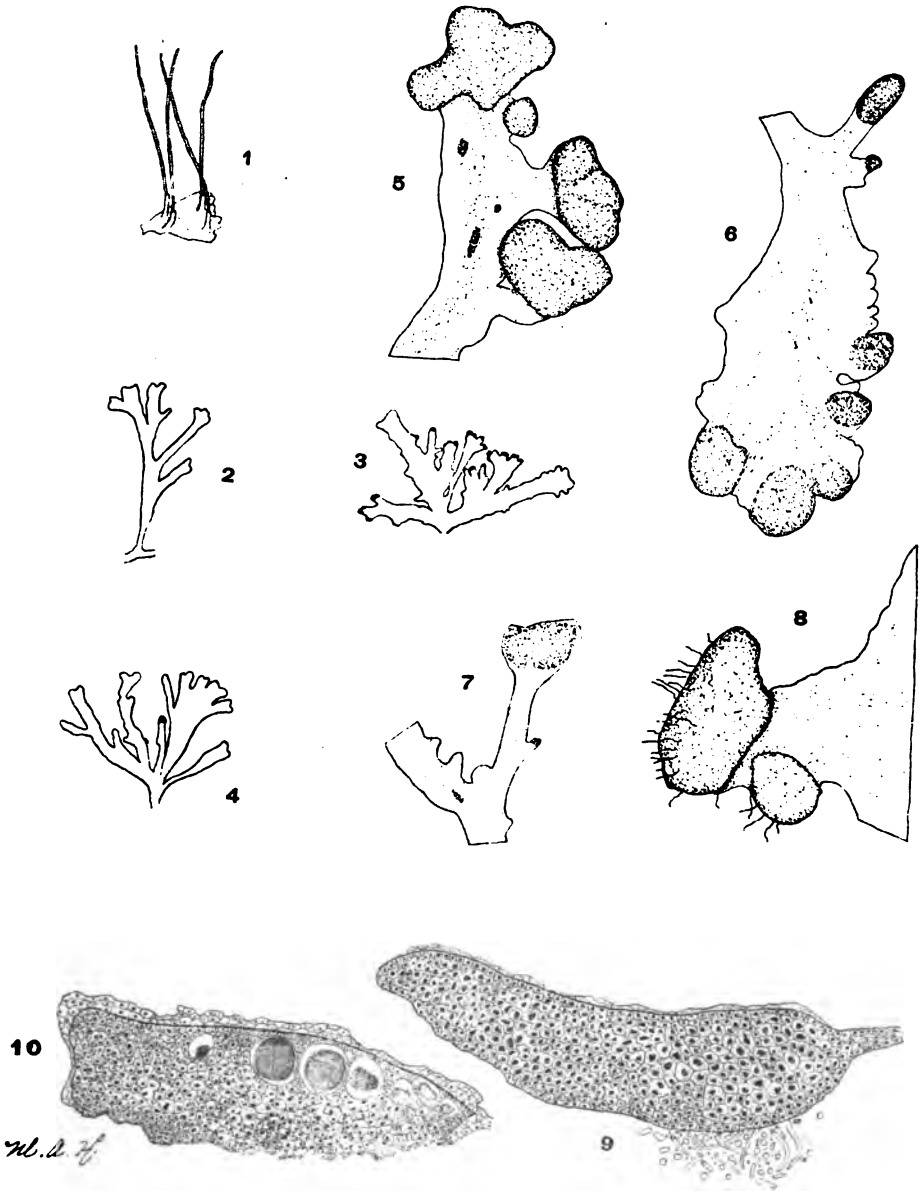




9-17. ANTHOCEROS PHYMATODES M. A. Howe.

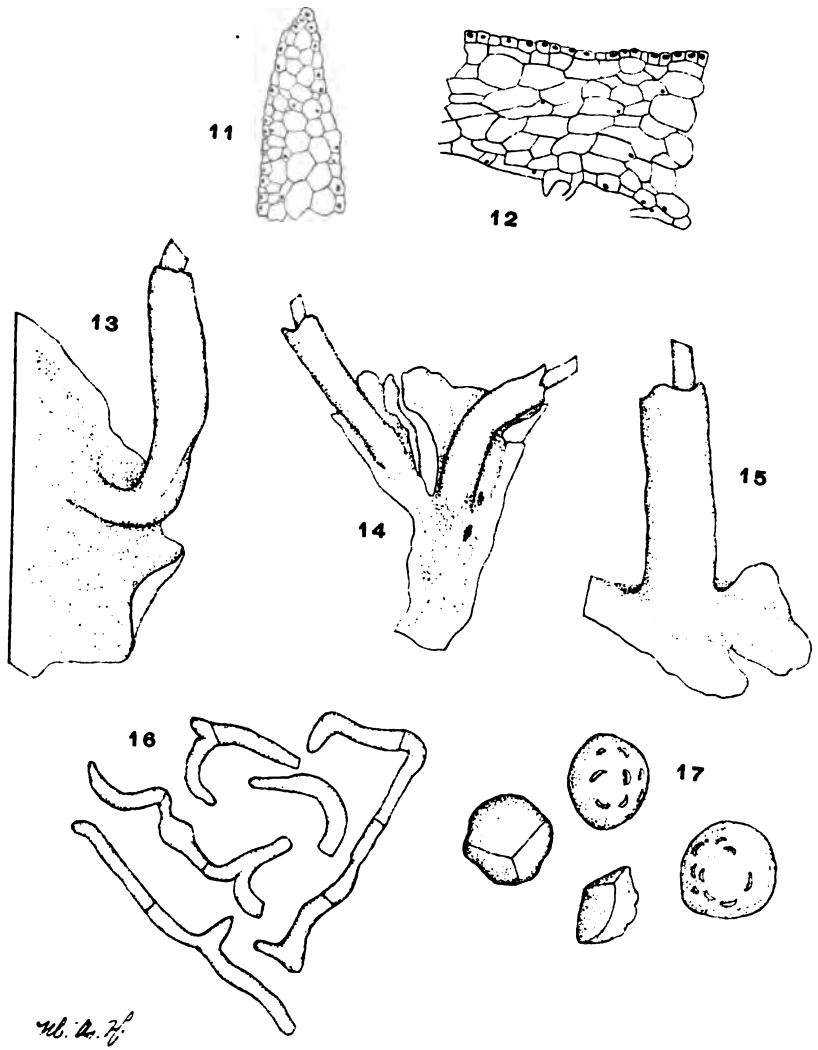
18. ANTHOCEROS POLYMORPHUS Raddi, γ DICHOTOMUS Raddi.

THE HELIOTYPE PRINTING CO., BOSTON



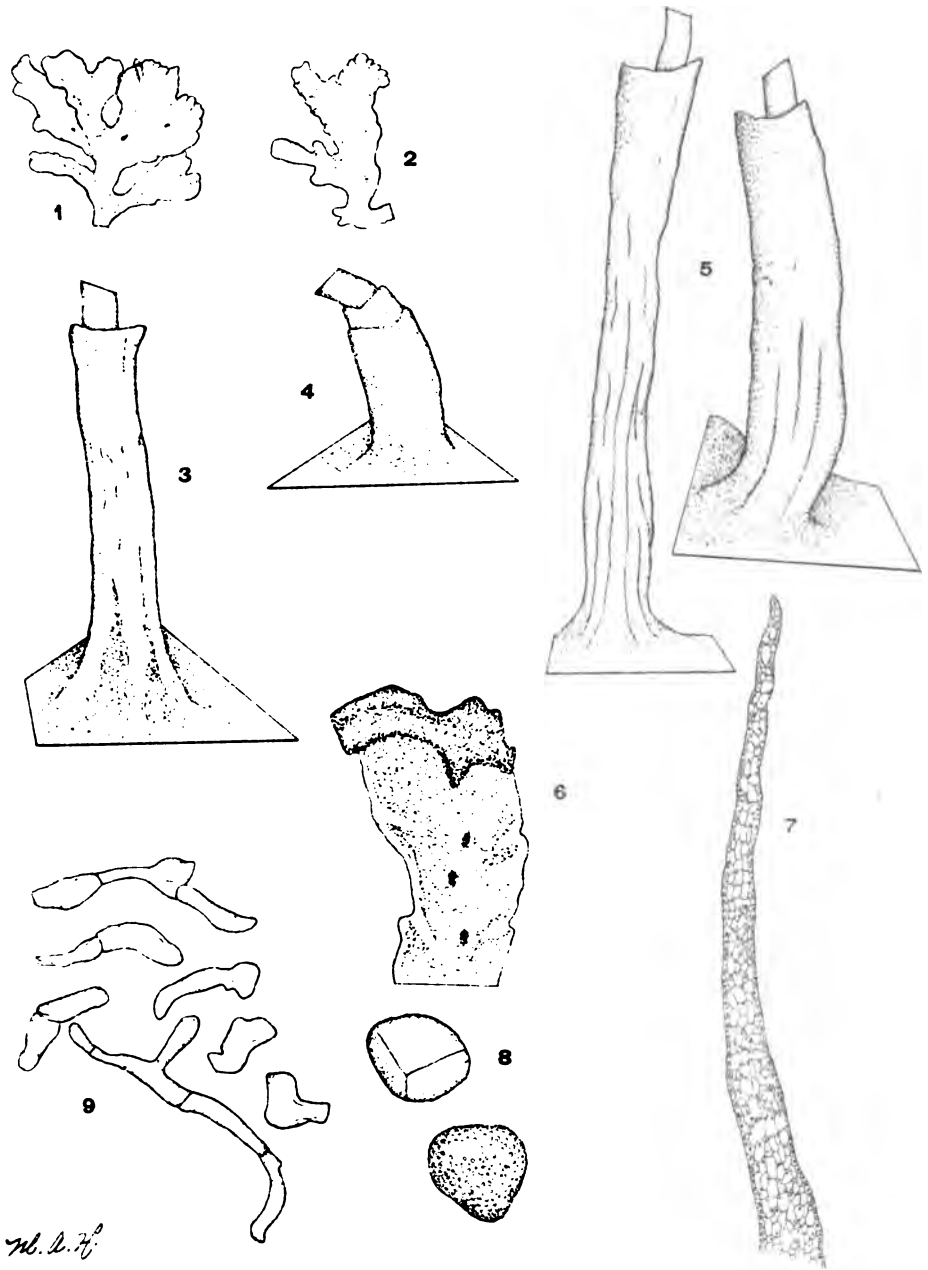
ANTHOCEROS PEARSONI M. A. Howe.

THE HELIOTYPE PRINTING CO., BOSTON



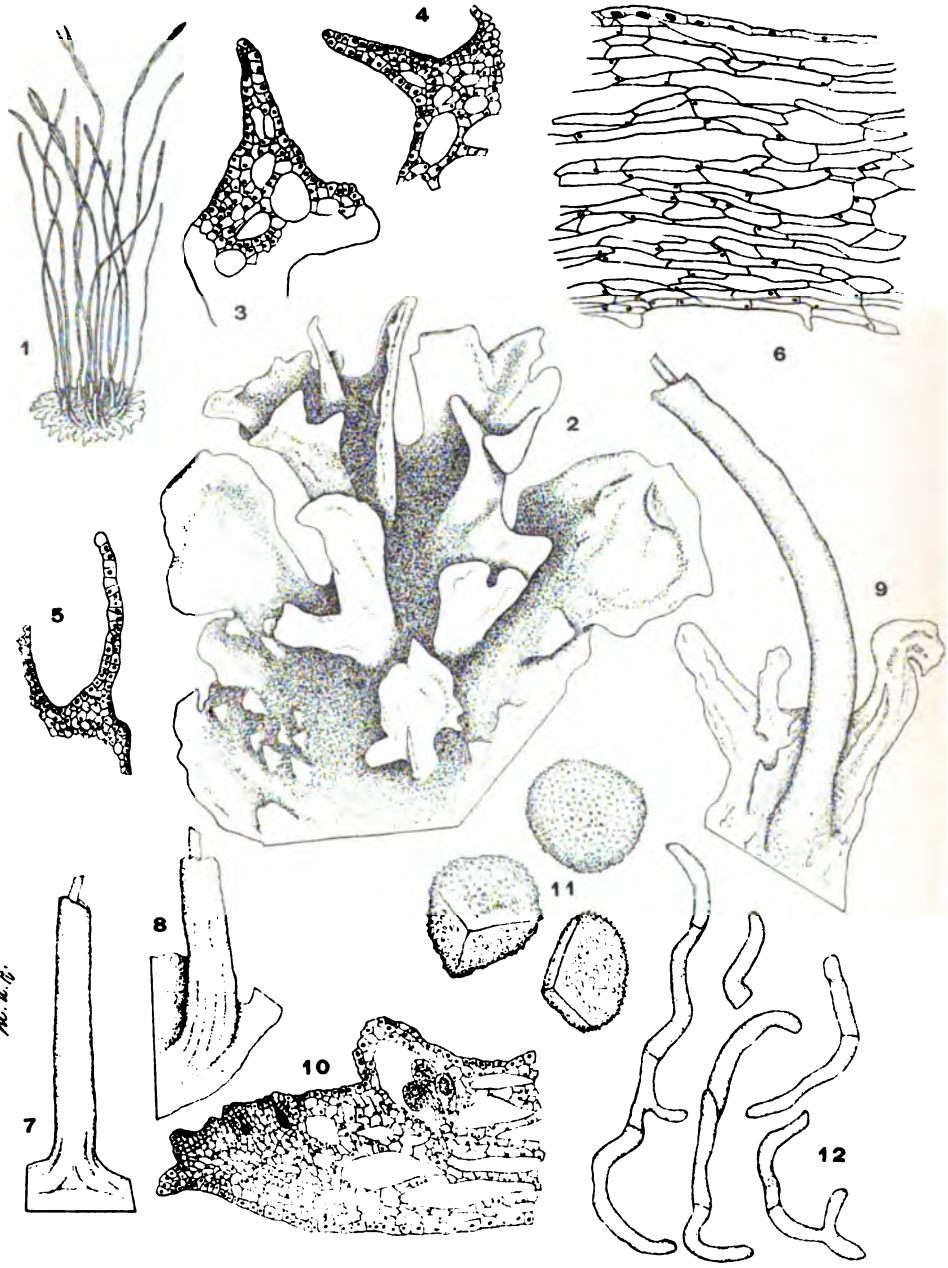
ANTHOCEROS PEARSONI M. A. Howe.

THE HELIOTYPE PRINTING CO., BOSTON



ANTHOCEROS CAROLINIANUS OCCIDENTALIS M. A. Howe.

THE HELIOTYPE PRINTING CO., BOSTON



ANTHOCEROS FUSIFORMIS Aust.

THE HELIOTYPE PRINTING CO., BOSTON

3 2044 103 104 27